Tiered Final Environmental Impact Statement: U.S. Coast Guard Rulemaking for Dry Cargo Residue Discharges in the Great Lakes

Prepared by

U.S. Coast Guard

in cooperation with

U.S. Environmental Protection Agency

February 2013

ES091709172941WDC

[Signature page.]

[Abstract page.]

[Report documentation page.]

Executive Summary

Background

Limestone, taconite (iron ore processed into pellets), coal, and other bulk dry cargoes have been shipped on the Great Lakes for many decades, and the shipment and use of such cargoes has been a major socioeconomic driver for many cities and industries on the Great Lakes. As part of the loading and unloading process, relatively small amounts of cargo inadvertently fall on a vessel's deck or in the tunnel underneath the cargo holds. This dry cargo residue (DCR) can pose safety hazards to a vessel's crew, who may slip on dust or small particles on deck or in the unloading tunnel, and can damage equipment. To alleviate these safety and operational hazards, DCR is washed or discharged from the deck or pumped overboard from the unloading tunnel in the lower hull.

DCR discharges were first regulated in 1993 through a U.S. Coast Guard Interim Enforcement Policy (IEP) that sought to balance commercial requirements with necessary safeguards to the Great Lakes environment. This policy allowed discharge of nonhazardous, nontoxic DCR only in defined areas of the Great Lakes that are generally relatively far from shore, thereby avoiding discharge in the most environmentally sensitive areas. The IEP was subsequently authorized by Congress on several occasions between 1998 and 2004. In 2004, Congress, through Section 623 of Public Law 108-293, gave the Coast Guard permanent authority to regulate the discharge of DCR on the Great Lakes, notwithstanding any other law.

Congressional authorization of the IEP expired in September 2008, causing the Coast Guard to consider regulatory alternatives to manage DCR discharges. To comply with the National Environmental Policy Act (NEPA), the Coast Guard released, in August 2008, an Environmental Impact Statement (the Phase I Final EIS), which evaluated regulatory alternatives. In September 2008, the Coast Guard issued an Interim Rule for Dry Cargo Residue Discharges in the Great Lakes (interim rule). An interim rather than final rule was issued because of data gaps identified in the Phase I Final EIS related to DCR discharge control measure costs and effectiveness.

Since then, additional data have been collected on the DCR discharge control measures that are used on vessels and at shoreside facilities and on DCR discharge information through vessel records and supplemental field measurements by the Coast Guard. This information was used in the development of this Tiered Final EIS. A "tiered" EIS is often used when an environmental evaluation is best conducted in two stages, with the first stage used to make timely decisions about programs, rules, or actions, and the second stage used to make determinations that require additional definition or data.

Phase I Final EIS

In the Phase I Final EIS, eight alternatives were initially identified and screened using criteria that addressed the purpose and need for managing DCR discharges, including consideration of environmental and economic impacts, efficiency, safety, energy use, and proven technology. Three were excluded as a result of this screening process. The five remaining alternatives included a variety of vessel and shoreside DCR management practices and modifications to areas where DCR discharges would be allowed.

The evaluation of these alternatives in the Phase I EIS concluded that with mitigation, all of the action alternatives (that is, aside from the No Action alternative) have similar and minor impacts on environmental resources (physical structure of the sediment, protected and sensitive areas, benthic community structure, invasive mussel species) and varying impacts on socioeconomic resources.

As a result of the evaluation, which identified data limitations on the effectiveness and costs of control measures, and input from public meetings, Alternative 2, adopting the IEP as the Coast Guard regulation with recordkeeping, was selected and incorporated as an interim rule. Under the interim rule, discharges of all DCR types were prohibited in special protection areas designated to protect sensitive ecological resources and near drinking water supply intakes. Through mitigation measures, discharges were also prohibited in or near national parks, national lakeshores, national wildlife refuges, national marine sanctuaries, a national estuarine research reserve, and other sensitive areas. Outside of these protected areas, this alternative allowed limestone and clean stone discharges without restriction and other nonhazardous discharges at specified distances from shore.

Purpose and Need

As with the Phase I EIS, the purpose of the Proposed Action in this Tiered Final EIS is to regulate nonhazardous, nontoxic DCR discharges from vessels in the Great Lakes that fall under the jurisdiction of the United States and to consider additional data collected to address gaps identified in the Phase I Final EIS. Based on the analysis of additional data, the interim rule could be modified, consistent with the authority granted in the Coast Guard and Maritime Transportation Act (CGMTA) of 2004, Public Law 108-293, § 623. The Act grants the Commandant of the Coast Guard, notwithstanding any other law, the permanent authority to promulgate regulations governing the discharge of DCR on the Great Lakes.

In considering additional DCR discharge alternatives in this Tiered Final EIS, the Coast Guard seeks to optimize the outcome for maritime safety, protection of natural resources, and maritime mobility, all of which, along with maritime security and national defense, are Coast Guard strategic goals. The Tiered Final EIS meets requirements under NEPA to inform the Coast Guard's decisions on regulating the discharge of DCR, to provide information on the likely environmental consequences of the Proposed Action and alternatives, and to inform the public and provide opportunities for public involvement and comment.

Additional Information Collection

The data gaps identified in the Phase I Final EIS were addressed in this Tiered Final EIS through an extensive evaluation of DCR discharge control measures constituting analysis of over 2,000 Coast Guard DCR reporting form entries submitted by vessel owner/operators and observing approximately 30 dry-cargo-loading and -unloading operations. The review and analysis of the reporting forms was informative in that it revealed much about the cargo-handling practices and variability in DCR management practices and quantities among various vessels and shoreside facilities. Due to the inconsistencies and other data entry issues in the vessel owner/operator submitted forms, the quantitative and statistical usefulness of the data was limited. Although the observation program data set was considerably smaller than the reporting form data set, the information was very consistent and useful in establishing the range of DCR discharge control practices used and the volume of DCR generated. The combined information obtained from evaluation of the forms and from observations permitted comprehensive evaluations of DCR quantities, control measures commonly employed, effectiveness of control measures, and input into the costing of alternatives.

Alternatives

The alternatives identified in the Phase I Final EIS plus additional alternatives identified during scoping and evaluation for this Tiered Final EIS were screened by comparing them to the purpose and need. Based on this screening, the following alternatives meet the Purpose and Need and are evaluated in detail in the Tiered Final EIS.

Alternative 1: No Action (Interim Rule with Recordkeeping)

The No Action alternative is required by NEPA to form the basis of a comparison for other alternatives and would be the continued implementation of the current DCR interim rule. Alternative 1 is a continuation of the DCR practices of the last several decades. Under Alternative 1, and as with the interim rule, all vessel owners and operators are encouraged, but not required, to reduce DCR discharges by implementation of voluntary DCR discharge control measures. The interim rule's recordkeeping and reporting requirements would continue to apply to all U.S. vessels transporting bulk dry cargo on the Great Lakes and any foreign vessel loading, unloading, or discharging DCR in U.S. waters of the Great Lakes. It would require quarterly submission of a Coast Guard DCR reporting form. The mandatory restrictions on some types of DCR discharges in nearshore waters, allowance of limestone and clean stone discharges in nearshore waters, and a broad restriction in other environmentally sensitive areas, including all areas so designated in the interim rule, would continue.

Alternative 2: Performance Requirement to Minimize DCR Discharges

Alternative 2 requires vessel owners/operators to minimize the discharge of DCR to the waters of the Great Lakes by maintaining a "broom-clean" standard on the vessel deck and implementing a management plan that minimizes DCR discharges from the deck and tunnel. Observations of DCR loading and unloading revealed that a significant reduction in DCR discharge can be achieved by careful attention to operations and by implementation of readily available discharge control measures that require minimal or no additional effort. Alternative 2 addresses a performance result (minimize DCR discharge) but does not mandate how the vessel owner/operator or shoreside facility should achieve the result. It charges the owners/operators, who best know their specific conditions and how they interact with shoreside facilities, to formulate the measure or measures most appropriate to their situations to minimize DCR discharges.

Alternative 2 includes the same DCR discharge exclusion areas as the No Action alternative and requires vessels to keep a record of DCR-related information onboard.

Alternative 3: Prescriptive Requirement for Baseline Control Measures

Alternative 3 would require all vessels and shoreside loading facilities to maintain and operate as designed a set of specific control measures that were observed to be effective at controlling DCR discharges if implemented, operated, and maintained properly. These control measures or their equivalents were observed on all vessels or shoreside loading facilities evaluated during the preparation of the Tiered Final EIS. Unlike Alternative 2 (Performance Requirement to Minimize DCR Discharges), which requires a minimization of DCR discharges, Alternative 3 would require specific control measures that were found to be present on all facilities and vessels visited as part of the observation program. If a vessel did not have a required control measure, it would have to demonstrate that it had a control measure that achieves the same level of control or that the situation does not warrant the specified control measure.

The DCR discharge exclusion areas and recordkeeping requirements for Alternative 3 are the same as those required for Alternative 2.

Affected Environment

As described in the Phase I Final EIS, existing conditions in the Great Lakes reflect the ongoing practice of DCR discharge as it has been occurring for over a century. An extensive literature review and site-specific investigations were conducted for the Phase I Final EIS to define the existing conditions and predict impacts from each alternative; socioeconomic conditions were examined in more detail as part of the Tiered Final EIS, to better assess the potential effects of regulatory changes and potential for significant economic impacts that might result. The additional characterization of socioeconomic conditions includes updated information on bulk dry carrier industry revenues, trends in the shipping industry, and the sensitivity of the bulk dry carrier shipping industry to economic conditions and incremental operating costs.

Environmental Consequences

In this Tiered Final EIS, the evaluation of environmental consequence, or impact assessment, process builds on the evaluation of alternatives and impact assessment undertaken for the Phase I Final EIS. It also is based on the evaluation of dry-cargo-handling and discharge procedures performed for the Tiered Final EIS. The influence of discharges under existing conditions is similar to the influence of discharges under the No Action alternative because

DCR discharging has been occurring in the Great Lakes for over a century. Resources considered for inclusion in the Tiered Final EIS fell into four impact categories:

- A determination of no impacts in the Phase I Final EIS and no additional evaluation required
- Impacts previously determined in the Phase I Final EIS to exist and to be reevaluated in the Tiered Final EIS
- Impacts identified in Phase I Final EIS but later determined not to result in an impact based on criterion modified for consistency reasons; no additional evaluation required
- No impacts determined in the Phase I Final EIS to exist but added for evaluation in the Tiered Final EIS on the basis of new information obtained from observations

Based on the evaluation of bulk-dry-cargo-handling procedures gained from the Coast Guard DCR reporting forms and the vessel observation program, the control of DCR discharge volumes resulting from the implementation of each alternative relative to current practices were estimated. This DCR volume and how the reductions could potentially be achieved were used in the prediction of impacts and cost estimating.

In most cases, where a determination of no impacts had been previously made, potential impacts under the Tiered Final EIS alternatives would be the same as or less than those determined in the Phase I Final EIS because of the potentially reduced discharge of DCR associated with the alternative. For those resource categories determined in the Phase I Final EIS to not result in an impact, the Phase I Final EIS completely describes the basis for the determination of no adverse impact, and thus those categories are not reconsidered here.

Resource areas where an impact had previously been determined to exist were evaluated in the Tiered Final EIS for the new alternatives. These resource areas included sediment physical structure, benthic community, invasive mussel species in lakes Michigan and Huron, and socioeconomic resources.

The Phase I Final EIS identified a possible impact on protected and sensitive areas. However, for this Tiered Final EIS, the impact criteria for protected and sensitive areas were refined to be consistent with criteria for other resource areas. Under the refined criteria there would be no impact on protected and sensitive areas, and therefore this resource is not evaluated in detail in the Tiered Final EIS.

Finally, observations conducted for this Tiered Final EIS revealed that under the current interim rule (No Action alternative), which does not prohibit the discharge of limestone and clean stone DCR within 3 statute miles of shore, discharges can occur while vessels are stationary at docks or other nearshore areas, where currents and mixing are limited and thus concentrated areas of DCR deposition are possible. Consequently, resource areas that might be adversely affected from the nearshore deposition of limestone and clean stone were included in the Tiered Final EIS impact evaluation, despite the fact that the Phase I Final EIS determined that there was no adverse impact. These resource categories, which were added to the evaluation, include DCR deposition rate and invasive mussel species in lakes Ontario, Erie, and Superior (the Phase I Final EIS had predicted invasive mussel impacts only to Lakes Michigan and Huron).

The consequences, or impacts, of **Alternative 1, No Action: Interim Rule,** are considered the same as those described for current practices, since a similar DCR discharge scenario has been occurring in the Great Lakes for over a century, and with the IEP in place since 1993. Significant short-term, long-term, and cumulative impacts to sediment physical structure, sediment deposition rate, benthic communities, and invasive mussel species in nearshore areas are predicted as a result of the potential for limestone and clean stone DCR discharges within 3 statute miles of the shore while vessels are stationary at loading or unloading docks. Multiple discharges of stone at port and nearshore areas could completely alter the existing sediment physical structure and potentially affect the benthic habitat. In changing the sediment structure, optimum conditions would be created in nearshore areas for invasive mussel habitat. There are no costs associated with this alternative because it is a continuation of the status quo. Thus impacts to socioeconomic resources are not anticipated.

The impacts of **Alternative 2, Performance Requirement to Minimize DCR Discharges,** are less than those of the No Action alternative, with an estimated decrease over the No Action alternative in DCR discharge volumes ranging from approximately 54 percent to 85 percent, with the variation representing different cargo types and differences between loading and unloading events. This estimated decrease is a result of the requirement to maintain a "broom-clean" standard on the vessel deck and implement a management plan that minimizes DCR discharges from the deck and tunnel. Also, since the DCR discharge controls are voluntary under the No Action alternative, there is the potential for the volume of DCR discharge per event to increase in the future. In contrast, the requirement to develop, maintain, and update a DCR management plan would essentially prevent increases in per-event DCR discharges in the future. Significant short-term, long-term, and cumulative impacts are associated with sediment deposition rate, and insignificant impacts are associated with sediment physical structure, the benthic communities, and invasive mussel species. Significant impacts to sediment deposition rate in port and nearshore areas result from combined natural and DCR annual deposition rates that are more than triple natural deposition rates. DCR deposition rates in open waters did not result in an impact. Similarly, impacts associated with other resource areas would be less in open water areas. Impacts to socioeconomic resources would not occur. Even at the high end of estimated costs, they are well below the level that would result in an impact.

The impacts of **Alternative 3, Prescriptive Requirement for Baseline Control Measures,** are similar to those of Alternatives 1 and 2. Although the volume of DCR discharged for this alternative is predicted to be 17 to 62 percent less than that discharged under the No Action alternative, the continued discharge of limestone and clean stone in port and nearshore areas is expected to be the same as for the No Action alternative, resulting in the same significant impacts to sediment physical structure, sediment deposition rate, benthic communities, and invasive mussel species. Impacts to socioeconomic resources would not occur. This alternative assumes all vessels and shoreside facilities have all baseline control measures. Consequently, costs associated with this alternative would be slightly less than those for Alternative 2.

Impact Mitigation

Prohibiting limestone and clean stone DCR discharge within 3 statute miles of shore would substantially mitigate the impacts on sediment physical structure, deposition rate, benthic community, and invasive mussels. It would result in no impact for most resources and would reduce impacts from significant to insignificant in others, as described above for impacts in nearshore areas and as summarized in Table ES-1.

Except in the Western Basin of Lake Erie, vessels could delay discharging limestone and clean stone DCR until they are beyond 3 statute miles of shore, but not incur any delays or additional costs. In the Western Basin of Lake Erie, vessels carrying limestone or clean stone might not travel beyond 3 statute miles from shore. However, as with other cargo types, if vessels restricted DCR discharges to the dredged navigation channels, they would neither incur any additional costs nor create adverse impacts to native sediment or benthos.

No impacts were predicted for economic resources, and consequently no socioeconomic mitigation was identified.

Comparison of Alternatives and Conclusions

Both of the action alternatives (Alternatives 2 and 3) impose requirements to control DCR discharge. The least estimated DCR discharge volume would be achieved with Alternative 2. For both action alternatives, the lower estimated volumes (compared to current practices) are associated with controlling the largest DCR sources, that is, the few large-volume events that contribute most of the DCR volume. Vessel records for loading events and observation data for all events indicate that over 50 percent of total DCR volume originated from just 3 to 7 percent of DCR discharge events.

Impacts from Alternatives 1 and 3 are similar, with significant impacts to sediment physical structure, sediment deposition rate, benthic communities, and invasive mussel species in nearshore areas as a result of the potential for limestone and clean stone DCR discharges within 3 statute miles of the shore while vessels are stationary at loading or unloading docks. Socioeconomic impacts are not predicted for any of the alternatives, although similar incremental costs would be present for Alternatives 2 and 3.

Because of the lower estimated DCR discharge volumes and reduced impact to affected resources in nearshore and port areas, Alternative 2, Performance Requirement to Minimize DCR Discharges, is the Coast Guard's preferred alternative. This alternative would require maintaining a "broom-clean" standard on the vessel deck and implementing a management plan that minimizes DCR discharges from the deck and tunnel. It also includes a requirement for vessels to keep onboard records of DCR-related discharge information and would continue existing DCR discharge exclusion areas. Mitigation of nearshore and port impacts would be included through a prohibition of limestone and clean stone DCR discharges within 3 statute miles of shore. In the Western Basin of Lake Erie, vessels not traveling beyond 3 statute miles from shore could discharge DCR within dredged navigation channels and not create adverse impacts to native sediment or benthos.

TABLE ES-1
Comparison of Alternatives Based on Significance Criteria

	1—No Action		2—Minimize DCR Discharges		3—Baseline Control Measures	
Resource Category	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Sediment Quality						
Sediment physical structure	●	◍	◍	◌	●	◍
Sediment deposition rate	●	○	●	○	●	○
Biological Resources						
Benthic community	●	◍	◍	◌	●	◍
Invasive mussel species—Lake Ontario, Lake Erie, Lake Superior	●	○	◍	○	●	○
Invasive mussel species—Lake Michigan, Lake Huron	●	◍	◍	◌	●	◍
Socioeconomic Resources						
Economic systems—bulk dry carrier industry	○	○	○	○	○	○
Economic systems—industries dependent on great lakes waterborne bulk dry shipping	○	○	○	○	○	○
Water-dependent infrastructure—commercial shipping lanes	○	○	○	○	○	○
Water-dependent infrastructure—port facilities	○	○	○	○	○	○

○ No adverse impact.
◌ Impact, but less than an insignificant (minor) adverse impact.
◍ Insignificant (minor) adverse impact.
● Significant adverse impact.

Contents

Signature Page iii
Abstract v
Report Documentation Page vii
Executive Summary ix
Abbreviations and Acronyms xxi
Glossary xxiii
1 Introduction 1-1
1.1 Background and History 1-1
1.2 Tiered Final Environmental Impact Statement 1-2
1.2.1 Definition and Intent 1-2
1.2.2 Application to DCR Rulemaking 1-2
1.3 Summary of Phase I Final EIS 1-2
1.3.1 Process 1-2
1.3.2 Selected Alternative 1-4
1.3.3 Conclusions 1-5
1.4 Purpose and Need 1-8
1.5 Public Involvement (for Tiered Final EIS) 1-8
1.6 Scope and Organization of Tiered Final EIS 1-9
1.7 Great Lakes Dry Cargo Shipping Industry Description 1-11
1.7.1 Summary Description of Industry and Practices 1-11
1.7.2 Bulk Dry Cargo Handling 1-15
1.7.3 Dry Cargo Residue Control Measures 1-19
2 Description of Alternatives 2-1
2.1 Introduction 2-1
2.2 Identification of Alternatives 2-1
2.2.1 Phase I Final EIS Alternatives 2-1
2.2.2 Newly Identified Alternatives 2-2
2.3 Screening of Alternatives 2-3
2.3.1 Screening of Phase I Final EIS Alternatives 2-4
2.3.2 Screening of Newly Identified Alternatives 2-5
2.4 Alternatives for Detailed Analysis 2-6
2.4.1 Alternative 1: No Action 2-6
2.4.2 Alternative 2: Performance Requirement to Minimize DCR 2-7
2.4.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures 2-14
2.5 Comparison of Alternatives 2-18
3 Affected Environment 3-1
3.1 Introduction 3-1
3.2 Summary of Existing Conditions 3-2
3.2.1 Sediment Quality 3-2
3.2.2 Water Quality 3-4
3.2.3 Biological and Related Resources 3-5

3.2.4 Socioeconomic Environment 3-14
4 Environmental Consequences 4-1
4.1 Introduction 4-1
4.2 Standards of Significance Criteria 4-3
4.2.1 Sediment Physical Structure 4-5
4.2.2 DCR Deposition Rate 4-6
4.2.3 Benthic Community 4-6
4.2.4 Invasive Mussels 4-8
4.2.5 Socioeconomic Resources 4-8
4.3 Impacts Summary 4-9
4.4 Sediment Physical Structure 4-14
4.4.1 Alternative 1: No Action 4-14
4.4.2 Alternative 2: Performance Requirement to Minimize DCR 4-15
4.4.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures 4-15
4.5 DCR Deposition Rate 4-16
4.5.1 Alternative 1: No Action 4-16
4.5.2 Alternative 2: Performance Requirement to Minimize DCR 4-16
4.5.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures 4-17
4.6 Benthic Community 4-17
4.6.1 Alternative 1: No Action 4-17
4.6.2 Alternative 2: Performance Requirement to Minimize DCR 4-18
4.6.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures 4-18
4.7 Invasive Mussels 4-18
4.7.1 Alternative 1: No Action 4-18
4.7.2 Alternative 2: Performance Requirement to Minimize DCR 4-19
4.7.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures 4-19
4.8 Cumulative Impacts on Natural Resources 4-20
4.9 Socioeconomic Resources 4-20
4.9.1 Alternative 1: No Action 4-21
4.9.2 Alternative 2: Performance Requirement to Minimize DCR 4-22
4.9.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures 4-23
4.10 Impact Mitigation 4-24
4.11 Permits, Licenses, and Approvals 4-25
4.11.1 Alternative 1: No Action 4-25
4.11.2 Alternative 2: Performance Requirement to Minimize DCR 4-25
4.11.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures 4-25
5 Comparison of Alternatives 5-1
5.1 Introduction 5-1
5.2 Basis of Comparison 5-1
5.3 Relative DCR Reduction by Alternative 5-1
5.4 Relative Cost for Each Alternative 5-3

5.5 Relative Impacts for Each Alternative and Ranking ... 5-4
5.6 Preferred Alternative ... 5-5
6 List of Preparers ... 6-1
7 List of Reviewers ... 7-1
8 References ... 8-1

Appendices

A Interim Rule for Dry Cargo Residue Discharges in the Great Lakes, September 29, 2008
B Notice for EIS Preparation, Including Public Scoping Meeting Announcement, and Summary of Comments Received
C Dry Cargo Residue Reporting Form Evaluation for Shipping Activity
D DCR Loading and Unloading Observations
E Estimated Costs of Alternatives Evaluated in Detail in the Tiered Final EIS
F DCR Discharge Exclusion Areas Specified in the Interim Rule
G Predicted Dry Cargo Residue Volumes of Alternatives
H Summary of EPA NPDES Vessel General Permit for Discharges Incidental to the Normal Operation as Related to U.S. Coast Guard DCR Rule
I Dry Cargo Residue Discharge Analysis for the U.S. Coast Guard
J Impact Analysis of Ongoing Dry Cargo Residue Practices
K Great Lakes Invasive Mussel Investigations Conducted in Support of U.S. Coast Guard Dry Cargo Residue EIS

Tables

ES-1 Comparison of Alternatives Based on Significance Criteria ... xvi

1-1 Summary Response to Comments on Phase I EIS ... 1-3
1-2 Comparison of Phase I Final Alternatives Based on Significance Criteria ... 1-6
1-3 Active Great Lakes Bulk Dry Cargo Carriers from Phase I Final EIS ... 1-11
1-4 Carriage on the Great Lakes: 2000–2008 Shipping Seasons (U.S. Vessels, to Nearest Thousand Tons) ... 1-13
1-5 Comparison of Estimated DCR Discharge Relative to Total Transported Cargo: 2002 Shipping Season, U.S. and Canadian Vessels (in Tons) ... 1-18

2-1 Alternatives' Screening Criteria ... 2-4
2-2 Predicted DCR Discharge Volume per Discharge Event for Alternative 1: No Action ... 2-7
2-3 Summary of Estimated Total Alternative 2 (Performance Requirement to Minimize DCR) Costs for the U.S. and Canadian Bulk Dry Cargo Fleet Operating on the Great Lakes ... 2-13
2-4 Predicted DCR Discharge Volume per Discharge Event for Alternative 2: Performance Requirement to Minimize DCR ... 2-14
2-5 Baseline Control Measures ... 2-15
2-6 Summary of Estimated Total Alternative 3 (Prescriptive Requirement for Baseline Control Measures) Costs for the U.S. and Canadian Bulk Dry Cargo Fleet Operating on the Great Lakes ... 2-17
2-7 Predicted DCR Discharge Volume per Discharge Event for Alternative 3: Prescriptive Requirement for Baseline Control Measures ... 2-18

3-1 State-Listed Threatened or Endangered Fish Species Found in the Great Lakes 3-6
3-2 Protected and Sensitive Areas 3-8
3-3 Great Lakes Rate Savings Benefits 3-14
3-4 Great Lakes Navigation System Operations and Maintenance Costs for Fiscal Years 2009–2013 (Commercial Harbors) 3-18

4-1 Resources To Be Evaluated 4-2
4-2 Summary of Significance Criteria for Tiered Final EIS 4-4
4-3 CEQ Impact Categories 4-10
4-4 Predicted Reduction in DCR Discharge Volume per Discharge Event for Each Alternative 4-12
4-5 Summary of Estimated Total Incremental Costs for the Entire U.S. and Canadian Fleet (2009 U.S. Dollars) 4-22
4-6 Summary of Impacts for Resource Areas Affected by Mitigation 4-24

5-1 Predicted Reduction in DCR Discharge Volume per Discharge Event 5-2
5-2 Summary of Estimated Total Incremental Costs for the Entire U.S. and Canadian Fleet (2009 U.S. Dollars) 5-4
5-3 Comparison of Alternatives Based on Significance Criteria 5-7

Figures

1-1 Study Area 1-10
1-2 Cargo Hauled on the Great Lakes by U.S. Vessels 1-14
1-3 Single Conveyor with Telescoping Loading Chute Typical of Coal-Loading Operations 1-16
1-4 Multiple-Horizontal-Conveyor Loading Mechanism Typical of Taconite-Loading Operations 1-16
1-5 Self-Unloading System aboard a Typical Great Lakes Vessel 1-17
1-6 Representation of Cargo Unloading 1-18
1-7 Summary of Median DCR Volumes 1-26

2-1 Examples of Concentrated Areas of DCR on Vessel Decks 2-8
2-2 Examples of Concentrated Areas of DCR in Vessel Tunnels 2-8

3-1 Protected and Sensitive Areas 3-10

4-1 Distribution of Coal DCR Discharges, 2008–2009 Loading Events 4-13

Abbreviations and Acronyms

ANOVA	analysis of variance
ATB	articulated tug barge
CDF	confined disposal facility
CEQ	Council on Environmental Quality
CGMTA	Coast Guard and Maritime Transportation Act of 2004
CWA	Clean Water Act
DCR	dry cargo residue
DMMP	dredge material management plan
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
IEP	Interim Enforcement Policy
LCA	Lake Carriers' Association
MBTA	Migratory Bird Treaty Act of 1918
NEPA	National Environmental Policy Act of 1969
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
PAH	polycyclic aromatic hydrocarbon
ROD	record of decision
SOLEC	State of the Lakes Ecosystem Conference
VGP	vessel general permit

Glossary

Amortized capital cost	A capital cost that has been recovered (deducted) over a fixed period of time.
Analysis of variance (ANOVA) technique	Statistical comparison of two sample means to determine if the samples are from the same or a different population.
Area of concern	An area recognized by the International Joint Commission in which one or more of 14 beneficial uses are impaired or in which objectives of the Great Lakes Water Quality Agreement or local environmental standards are not being achieved because of contamination. In this Tiered Final EIS, the area of concern is primarily the open waters of the Great Lakes that lie within or near established shipping lanes.
Articulated tug barge (ATB)	A tug and a barge joined by an inflexible connection to operate as a single unit.
Baseline control measure	Structural device or operational procedure commonly used by vessels or shoreside facilities that reduce DCR discharges.
Belt scraper	A structural device that removes cargo stuck to a conveyor belt.
Benthic	Referring to organisms that live or feed on the sediment at the bottom of a water body such as an ocean, lake, or river.
Biomass	The mass of biological material derived from living or recently living organisms.
Broom clean	A condition in which deck residues consist only of dust, powder, or isolated and random pieces, none of which exceeds 1 inch in diameter.
Capacity indicator	A structural device that visually reports the available or exceeded capacity (e.g., tonnage) of a loading or unloading system (e.g., conveyor belt).
Cargo hold vibrator	A structural device on a vessel used to loosen by mechanical action and free stuck cargo from the hold, and produce a smooth and steady flow of bulk dry cargo to the unloading conveyor belt.
Coast Guard and Maritime Transportation Act of 2004, Public Law 108-293, §623	An act granting the Commandant of the Coast Guard, notwithstanding any other law, the permanent authority to promulgate regulations governing the discharge of DCR on the Great Lakes.

Commodity year	A period that, for Great Lakes waterborne purposes, corresponds to the weather-dependent shipping season, which generally starts on or around April 1 and ends on or around December 31.
Community	An assemblage of living populations of different species within a specified location in space and time. Sometimes a particular subgrouping may be specified, such as the fish community in a lake.
Confined disposal facility (CDF)	A confined disposal facility is a structure planned and designed to receive sediments dredged from a navigation channel and safely contain the sediments, preventing their reentry into a waterway or lake.
DCR reporting form	U.S. Coast Guard form CG-33 that requires vessels to report cargo types and activities related to generation and discharge of DCR
Deposition	The process by which material settles out of the atmosphere or water column and accumulates in ecosystems.
Direct impact	Changes in an environmental resource that are in immediate temporal or spatial proximity to an activity of an alternative.
Dredge material management plans (DMMPs)	The comprehensive evaluation of environmental consequences of specific proposed dredging and disposal actions through testing, and short- and long-term monitoring of dredged material disposal sites.
Dry cargo	Nonliquid cargoes typically in a granular or aggregate form. Dry cargoes include limestone and other clean stone, iron ore, coal, salt, cement, slag, grain, fertilizer, and wood chips. Dry cargo residues do not include residues of substances known to be toxic or hazardous, such as nickel, copper, zinc, or lead.
Dry cargo residue (DCR)	Remnants of dry cargo shipments inadvertently deposited outside cargo holds during the loading and unloading of cargo and other normal vessel operation.
Dust	Small-particle-size dry cargo residue often windborne or airborne and labor-intensive or infeasible to collect.
Ecosystem	The interacting system of a biological community and its nonliving environmental surroundings.
Enclosed conveyor belt	A conveyor belt where the top, sides, or bottom of the conveyor are covered.

Endangered species	Plant or animal threatened with extinction by anthropogenic or other natural changes in their environment. Requirements for declaring a species endangered are contained in the Endangered Species Act.
Eutrophic	A lake classification indicating a trophic state with nutrient enriched producing significant plant growth.
Exclusion area	Area within which discharging DCR is prohibited and penalized; generally stated in terms of a distance from land within which discharging DCR is not allowed.
Habitat	The place where a population lives and its surroundings, both living and nonliving, whether human, animal, plant, or microorganism.
Hopper	A device that receives cargo at a shoreside facility or at a transfer location between conveyor belts.
Indirect impact	Changes in an environmental resource that result from a direct impact of an alternative. They are one or more steps removed from an immediate temporal or special change in a resource.
Interim Enforcement Policy (IEP)	A policy implemented by the Ninth U.S. Coast Guard District in 1993, amended in 1995 and again in1997, which provides for the discharge of DCR in defined parts of the Great Lakes. Provided as Appendix A.
Invasive species	Plant or animal species that are usually non-native (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. They spread quickly and often uncontrollably.
Jones Act	Merchant Marine Act of 1920 which requires goods transported by water between U.S. ports to be carried by U.S. vessels constructed in the U.S., owned by U.S. citizens, and crewed by the same.
Loading chute	A structural device at the end of a conveyor belt that is typically completely enclosed, allowing the cargo to be directed downward into a cargo hold in a controlled manner.
Long-term impact	Changes in an environmental resource that persist as long as an alternative is active.
Mesotrophic	A lake classification between oligotrophic and eutrophic.

Mitigation	The process of taking measures to reduce adverse impacts on the environment, such as avoiding an action that may cause an impact; minimizing impacts by limiting the degree or magnitude of an action; repairing, rehabilitating, or restoring the affected environment; reducing or eliminating an impact over time by preservation and maintenance operations during the life of an action; and compensating for the impact by replacing or providing substitute resources or environments.
Nautical mile	A measurement equal to 1.15 statute miles.
Net revenue	Total revenues minus operating and maintenance costs.
Nonhazardous	Any material that does not pose a threat to human health and/or the environment and is not toxic, corrosive, ignitable, explosive, or chemically reactive. Any substance not designated by EPA to be reported if a designated quantity of the substance is spilled in the waters of the United States or is otherwise released into the environment.
Non-self-propelled barge	A non-motorized water vessel, usually flat-bottomed and towed or pushed by other craft, used for transporting freight.
Nutrient enrichment	Addition of inorganic compounds required for plant growth.
Oligotrophic	Lake classification indicating a trophic state with low nutrient concentration and low plant growth.
Pelagic	Referring to the part of a lake that is not near the shoreline or lake bottom; open water.
Plankton	The collection of small or microscopic organisms, including plants and animals, that float or drift in great numbers in fresh or salt water, especially at or near the surface, and serve as food for fish and other larger organisms.
Planktonic	Free floating in the water column.
Polycyclic aromatic hydrocarbons (PAHs)	A mixture of organic compounds released into the atmosphere as gases or particles during the incomplete combustion of organic material. Sources include cars, trucks, ships, aircraft, and industrial power generation. PAHs are identified as potential contaminants in drinking water that may have health effects.
Profit margin	A ratio of profitability calculated as net income divided by revenues; or what remains from sales after a company pays out the cost of goods sold.

Protected and Sensitive Area	There are two types of protected and sensitive areas throughout the Great Lakes: those designated for protection or management by State or Federal agencies and those identified as sensitive habitat during a multiagency and stakeholder workshop on managing DCR. See Figure 3-1 and Table 3-2.
Relative cost	The cost of a commodity such as a good or service in terms of another commodity.
Sediment	Soil, sand, and minerals washed from land into water, usually after rain. Also, the unconsolidated materials that settle at the bottom of the Great Lakes, consisting of particles of sand, clay, silt, and other substances derived from eroding soil and from decomposing plants and animals.
Self-unloading vessel	A vessel that can unload its cargo with little or no assistance from a shoreside facility.
Sensitive habitat	Any area in which plant or animal life is either rare or especially valuable or any habitat that supports endangered or threatened species.
Shipping lane	An established route for large cargo-carrying vessels along which ships are advised to navigate because the route has been specially examined to ensure as far as possible that it is free of dangers. Typically shown on navigational charts. Not enforced by law due to weather, safety, or other issues that may cause a vessel to reroute.
Shoreside facility	A facility on a navigable waterbody where vessels load and unload cargo.
Short-term impacty	Changes in an environmental resource that are finite in duration, do not persist for the entire duration of the alternative, and occur generally immediately upon implementation of an alternative.
Significance	Significance is determined by the intensity or severity of an impact (the effect of discharging a chemical to the environment, for example) and the context in which it occurs. Criteria for evaluating potential impacts and determining their significance are outlined by the Council on Environmental Quality in the definition of “significantly” (40 CFR 1508.27).
Skirting	A structural device, typically located along a conveyor belt or at a transfer location between conveyor belts, that prevents cargo from falling off the sides of a conveyor belt.
Socioeconomic	Of or involving social and economic factors.
Spawning area	Fish-breeding area.

Special protection area	Those areas established in the IEP to protect sensitive ecological resources, such as fishery spawning and nursery grounds, and drinking water supply intakes. Special protection areas are excluded from discharge activities.
Statute mile	A measurement equal to 0.87 nautical mile.
Straight line depreciation	A method of calculating the depreciation of an asset which assumes the asset will lose an equal amount of value each year.
Substrate	Bottom sediment material in a natural water system.
Taconite	Low-grade iron ore that is processed into pellets approximately 1 centimeter in diameter.
Threatened species	Any species likely to become "endangered" within the foreseeable future throughout all or a significant part of its range. A species of wildlife or plants listed as "threatened" pursuant to a specific act (e.g., Endangered Species Act, CITES).
Track line	The actual path a vessel travels; depending on conditions, may be the same as a shipping lane. See also *shipping lane*.
Trophic state	A lake classification system indicating the relative clarity and biological activity occurring in a lake, both of which are tied to nutrient enrichment.
Troughed conveyor	A conveyor belt that has a cross-section in or similar to a **U** shape.
Tug-and-barge unit	A vessel where the stern is notched to accept a special tug that can be rigidly connected to the barge, forming a single vessel. See also *articulated tug barge*.
Vertical integration	When a firm owns its upstream suppliers and controls its inputs to a greater degree.
Vessel General Permit (VGP)	A permit established by EPA in 2008 to regulate discharges incidental to the normal operation of vessels operating in a capacity as a means of transportation. The following are not subject to VGP requirements: 1) recreational vessels as defined in the Clean Water Act and, 2) with the exception of ballast water discharges, non-recreational vessels less than 79 feet in length, and all commercial fishing vessels, regardless of length.
Vessel tunnel	Area of a vessel below deck outside of cargo holds.
Washwater	Water used to clean vessel decks and loading and unloading equipment.

CHAPTER 1

Introduction

1.1 Background and History

Limestone, taconite (iron ore processed into pellets), coal, and other bulk dry cargoes have been shipped on the Great Lakes for many decades, and the shipment and use of such cargoes has been a major socioeconomic driver for many cities and industries on the Great Lakes. Incidental to the shipping are relatively small amounts of cargo that inadvertently fall on the decks or in tunnels under the vessel's deck as cargo is loaded and unloaded. This dry cargo residue (DCR) can pose safety hazards to vessel crews, who may slip on dust or small particles on decks or in unloading tunnels, and damage equipment. To alleviate these safety and operational hazards, DCR is washed or discharged from the deck or pumped overboard from the unloading tunnels in the lower hull.

The discharge of DCR was unregulated until 1993, when in response to Congressional authorization, the U.S. Coast Guard's Ninth District adopted an Interim Enforcement Policy (IEP). The IEP sought to reasonably balance commercial requirements with necessary safeguards for the Great Lakes environment by allowing the discharge of DCR only in defined portions of the Great Lakes that are relatively far from the shore, thereby avoiding DCR discharges to environmentally sensitive areas.

Congressional authorization of the IEP expired in September 2008. In anticipation of the IEP's expiring, and to comply with the National Environmental Policy Act (NEPA), the Coast Guard had prepared an Environmental Impact Statement (EIS) and, upon the IEP's expiration, issued the Interim Rule for Dry Cargo Residue Discharges in the Great Lakes (interim rule), which regulated management of DCR (Appendix A).

The Phase I Final EIS, released in August 2008, presents a comprehensive evaluation of DCR. However, it identified data gaps related to DCR discharge control measure costs and effectiveness and thus supported the Coast Guard's position issuing an interim, rather than a final, rule.

This Tiered EIS supports final rulemaking by addressing these data gaps; as such, most of the Phase I Final EIS information used here is referenced or summarized rather than repeated. (A full description of the history and regulatory background of DCR rulemaking is presented in Section 1.4 of the Phase I Final EIS.)

As was the case with the Phase I Final EIS, the specific intent of this EIS is to provide analysis to inform the Coast Guard's decisions on regulating the discharge of DCR, to provide information on the likely environmental consequences of the Proposed Action[1] and

[1] The authority for the Proposed Action is the Coast Guard and Maritime Transportation Act of 2004, Public Law 108-293, §623. The Act grants the Commandant of the Coast Guard, notwithstanding any other law, the permanent authority to promulgate regulations governing the discharge of DCR on the Great Lakes. The Proposed Action will fulfill the Coast Guard's need to provide regulations with clear and concise definitions and expectations. In exercising its authority under Public Law 108-293, the Coast Guard seeks to optimize the outcome for maritime safety, protection of natural resources, and maritime

alternatives, to inform the public and provide opportunities for public involvement and comment, and to comply with NEPA requirements.

1.2 Tiered Environmental Impact Statement

1.2.1 Definition and Intent

A "tiered" EIS is often used when an environmental evaluation is best covered in two stages. In the first stage, the lead agency focuses on decisions and issues that are ripe for decisionmaking, either because those elements of the proposed action are well defined with respect to components and geographic location or because adequate background data are available to use in making a well-reasoned decision.

In the second stage, elements of the project that have been determined to need additional definition or data prior to evaluation are considered. These elements may relate to specific components of an alternative or to mitigation. In "tiering" an EIS, lead agencies have the opportunity to make timely decisions about programs, rules, and actions and then clarify or augment those decisions as additional data become available.

1.2.2 Application to DCR Rulemaking

As described above, a final rulemaking was deferred until additional data could be collected on DCR discharge control measure costs and effectiveness. These data included the following: an inventory of the control measures used on vessels and at shoreside facilities, DCR discharge information collected by vessels and compared to supplemental field measurements, a quantification of DCR discharge volumes under various conditions, measurements of the effectiveness of individual or of clusters of control measures used to reduce DCR discharge, a qualitative assessment of vessel and facility operations to reduce DCR discharge, and potential costs associated with changes in managing DCR.

With the benefit of these additional data on the use, effectiveness, and costs of various DCR discharge control measures, and on the amounts of DCR generated during loading and unloading operations as determined from the vessel records and direct observations, potential alternatives to managing DCR discharges can be considered. This Tiered Final EIS describes those additional alternatives, evaluates the potential environmental and socioeconomic impacts associated with them, and supports final rulemaking, as appropriate.

1.3 Summary of Phase I Final EIS

1.3.1 Process

In developing the Phase I Final EIS, reasonable alternative courses of action that met the Coast Guard's goals of regulating nonhazardous, nontoxic DCR discharges from vessels in the Great Lakes were considered. Eight alternatives were identified and then screened using criteria that addressed the purpose and need, including consideration of environmental and economic impacts, efficiency, safety, energy use, and proven technology. Applying these criteria reduced the number of alternatives to five, including a No Action alternative. Those

mobility, all of which, along with maritime security and national defense, are Coast Guard strategic goals. These objectives will be used to identify alternatives that meet the purpose and need.

alternatives, which included differing vessel and shoreside DCR management practices and modifications to areas where DCR discharge would be permitted, were evaluated in detail in the Phase I Final EIS; they are summarized in Section 2.2 of this Tiered Final EIS and listed below:

- Alternative 1: No Action (allow IEP to expire)
- Alternative 2: Proposed Action (IEP with recordkeeping)—Coast Guard preferred alternative
- Alternative 3: Proposed Action with Modified Exclusion Areas
- Alternative 4: Proposed Action with DCR Control Measures on Vessels
- Alternative 5: Proposed Action with Shoreside DCR Control Measures

Potential environmental impacts to resources that could be affected by any of the DCR management alternatives were assessed in detail using information collected in the field and through laboratory testing of lake-bottom sediments and DCR. The potentially affected resources included sediment quality, water quality, and biological resources.

In addition, potential impacts to socioeconomic resources were evaluated. Other resource categories, such as geology, topography, air quality, and land use were considered but not evaluated further, because they were outside of the area potentially affected by DCR discharges. The impacts of various alternatives were determined by comparing the elements of each alternative to the existing conditions found in the Great Lakes and to the No Action alternative. This comparison process is for most EISs a forecast, or prediction, but because DCR has been discharged for over a century and impacts can be measured, the impact assessment was based on current conditions.

Following its completion, the Phase I Draft EIS was made available for public and agency review, and public meetings were held to obtain additional input. The input and response to comments were summarized in Section 1.2 of the Phase I Final EIS, and are provided in an abbreviated form in Table 1-1.

As a result of the environmental evaluation, which identified data limitations on the effectiveness of DCR discharge control measures, and input from public meetings, Alternative 2, adopting the IEP as the Coast Guard regulation with recordkeeping, was selected.

TABLE 1-1
Summary Response to Comments on Phase I Draft EIS

Comment	Summary Response
DCR discharge should be illegal.	Although potentially environmentally beneficial, an alternative eliminating DCR discharge would have a significant adverse socioeconomic impact, jeopardize the viability of the shipping industry, and have indirect significant adverse impacts on associated industries and commerce. This was evaluated as the No Action alternative.
There are toxic constituents in DCR.	Testing of primary cargo types, sediments and animal tissue, and toxicity effects of lake sediments did not demonstrate a risk associated with chemicals in DCR.

TABLE 1-1
Summary Response to Comments on Phase I Draft EIS

Comment	Summary Response
There are effects on the Great Lakes' ecosystem, including invasive mussels.	Scientific studies conducted in support of the Phase I Draft EIS revealed minor adverse effects on some of the aquatic resources including invasive mussels (Table 1-2); these effects were considered in promulgating the interim DCR rule.
DCR discharge is illegal.	The Coast Guard has the authority to regulate the discharge of DCR in the Great Lakes by Congressional authorization (2004), "notwithstanding any other law." This authority does not preempt state laws that may prohibit solid waste discharge in the Great Lakes, and state laws are not believed to conflict with an overriding Federal purpose in regulating DCR.
Recordkeeping requirement is unnecessary.	Recordkeeping has a demonstrated value in supporting compliance, with minimal costs. It is also expected to assist the Coast Guard in estimating effectiveness of DCR control measures.

1.3.2 Selected Alternative

Under Alternative 2, the Preferred and Selected Alternative, which took effect as an interim rule on September 29, 2008 (*Federal Register*, 2008), DCR discharge practices were continued but with new requirements for protecting additional Great Lakes' sensitive areas and for standardized recordkeeping by vessels that discharge DCR. The regulation applies to U.S. vessels anywhere in the Great Lakes and to vessels of any nation operating in the U.S. waters of the Great Lakes.

Under the interim rule, DCR discharge generally is allowed as follows:

- Limestone and clean stone discharge are allowed without restriction.
- Taconite discharge is generally allowed beyond 6 statute miles from shore, with a greater exclusion area established for shallow water shoals and islands in Lakes Superior and Michigan.
- Coal, salt, cement, and other nonhazardous materials discharge is allowed beyond 13.8 statute miles from shore.

Modifications to areas where discharging is allowed and excluded would continue to fall into the two categories identified in the IEP (U.S. Coast Guard, 1997):

- Special protection areas—those areas established to protect sensitive ecological resources, such as fishery spawning and nursery grounds, and drinking water supply intakes—are excluded from discharge activities.
- Special rules—exemptions to exclusion areas—continue to allow discharging where it is necessary for economical transport of dry cargo.

Mitigation activities identified in the Phase I Final EIS were determined to reduce potential impacts to protected and sensitive resource areas. Therefore, the list of special protection areas, where discharge is prohibited, was expanded to include national parks, national lakeshores, national wildlife refuges, national marine sanctuaries, and a national estuarine research reserve.

Under the selected alternative, which was adopted in the interim rule, recordkeeping is mandatory, consistent with accepted environmental management practices, to provide a variety of data related to loading and unloading locations, types of control measures used to control DCR, the date and time of discharge, type and quantity of discharged material, and the location of the discharge. Records are submitted quarterly to the Coast Guard. Data for the first three quarters of vessel monitoring have been evaluated to support the analysis included in this Tiered Final EIS and to contribute to future decisionmaking and management of DCR.

1.3.3 Conclusions

The Phase I Final EIS concluded that all of the action alternatives (except the No Action alternative) have similar impacts on environmental resources and varying impacts on socioeconomic resources. It also concluded that there would be no impacts to most resource areas. Impacts to five resource areas (Table 1-2) were identified:

Physical Structure of the Sediment. In historically higher-intensity DCR discharge areas, there is a minor, indirect adverse impact on the physical characteristics of lake-bottom sediments.

Protected and Sensitive Areas. Where discharging of DCR is allowed in protected and sensitive areas, a direct significant adverse impact on these areas could result.

Benthic Community Structure. Although there was no direct evidence of DCR effects on the benthic community as a result of discharges, a change of the sediment physical structure could cause a small, localized, and insignificant adverse impact on the relative abundance of the native species in the sediment.

Invasive Mussel Species. Laboratory studies revealed a preference for invasive adult mussel species (zebra and quagga) to attach to substrates containing DCR; in combination with other factors, this preference could potentially contribute to the spread of invasive mussel species. In Lakes Erie and Ontario, mussel densities are already high, and continued discharge of DCR is not expected to affect the populations in these lakes. In Lake Superior, factors such as temperature, depth, and calcium concentrations prevent the establishment of invasive mussel populations. The Phase I Final EIS concluded that in Lakes Michigan and Huron, the continued discharge of DCR could have a minor indirect adverse impact by increasing invasive mussel species habitat for adult mussels. Laboratory tests showed that DCR deposited on the lake bottom and covered with natural sedimentation did not constitute enhanced habitat for immature mussels.

Socioeconomic Resources. Socioeconomic impacts were determined to be significant for the No Action alternative, which would have prohibited any DCR discharge and required a change in vessel and shore operations, with significant associated costs. Socioeconomic impacts associated with a continuation of the IEP and the addition of mandatory recordkeeping (Proposed Action) were not predicted to be adverse. Modification of DCR discharge exclusion areas (Alternative 3) would produce minor (insignificant impact) if vessels had to go out of their way to get to an area where they could discharge.

TABLE 1-2
Comparison of Phase I Final Alternatives Based on Significance Criteria

Resource Category	No Action	Proposed Action—Coast Guard Preferred Alternative: Without Mitigation[a]	Proposed Action—Coast Guard Preferred Alternative: With Mitigation[a]	Modified Exclusion Areas	DCR Control Measures: Vessel	DCR Control Measures: Vessel with Mitigation[a]	DCR Control Measures: Shore	DCR Control Measures: Shore with Mitigation[a]
Sediment Quality								
Sediment chemistry	○	○	○	○	○	○	○	○
Sediment physical structure	○	◍	◍	◍	◍	◍	◍	◍
DCR deposition rate	○	○	○	○	○	○	○	○
Water Quality								
Water chemistry	○	○	○	○	○	○	○	○
Dissolved oxygen	○	○	○	○	○	○	○	○
Nutrient enrichment	○	○	○	○	○	○	○	○
Biological Resources								
Special-status species	○	○	○	○	○	○	○	○
Protected and sensitive areas	○	●	◌[b]	◌[b]	●	◌[b]	●	◌[b]
Benthic community[c]	○	◍	◍	◍	◍	◍	◍	◍
Fish, other pelagic organisms	○	○	○	○	○	○	○	○
Invasive mussel species—Lake Ontario, Lake Erie, Lake Superior	○	○	○	○	○	○	○	○

TABLE 1-2
Comparison of Phase I Final Alternatives Based on Significance Criteria

Resource Category	No Action	Proposed Action—Coast Guard Preferred Alternative: Without Mitigation[a]	Proposed Action—Coast Guard Preferred Alternative: With Mitigation[a]	Modified Exclusion Areas	DCR Control Measures: Vessel	DCR Control Measures: Vessel with Mitigation[a]	DCR Control Measures: Shore	DCR Control Measures: Shore with Mitigation[a]
Invasive mussel species—Lake Michigan, Lake Huron	○	◍	◍	◍	◍	◍	◍	◍
Waterfowl	○	○	○	○	○	○	○	○
Socioeconomic Resources								
Bulk dry cargo carrier industry	●	○	○	◍	◍	◍	○	○
Industries directly dependent on bulk dry cargo carriers	●	○	○	○	○	○	○	○
Commercial shipping lanes	○	○	○	○	○	○	○	○
Port facilities	●	○	○	○	○	○	◍	◍
Fishing	○	○	○	○	○	○	○	○

[a] The process of taking measures to reduce adverse impacts on the environment, such as avoiding an action that may cause an impact; minimizing impacts by limiting the degree or magnitude of an action; repairing, rehabilitating, or restoring the affected environment; reducing or eliminating an impact over time by preservation and maintenance operations during the life of an action; and compensating for the impact by replacing or providing substitute resources or environments.
[b] Corrected from Phase I Final EIS to reflect reduced impacts where DCR discharge is prohibited in sensitive areas and within 3 statute miles of lakeshores (Modified Exclusion Area Alternative), and where mitigation is implemented.
[c] Referring to organisms that live or feed on the sediment at the bottom of a water body, such as an ocean, lake, or river.

○ No adverse impact.

◌ Impact, but less than an insignificant (minor) adverse impact.

◍ Insignificant (minor) adverse impact.

● Significant adverse impact.

Socioeconomic impacts associated with the remaining alternatives, 4 and 5, which require control measures on vessels or at shore, respectively, could be adverse to vessels or shoreside facilities if improvements are required, but the cost to implement potential improvements was uncertain.

Because of the data gaps identified in the Phase I Final EIS related to DCR control measure costs and effectiveness, and the fact that environmental impacts associated with various alternatives were similar, the Coast Guard supported an interim rather than final rule. This Tiered Final EIS supports final rulemaking by addressing these data gaps.

1.4 Purpose and Need

As was the case in the Phase I Final EIS, the purpose of the Proposed Action is to regulate nonhazardous, nontoxic DCR discharges from vessels in the Great Lakes that fall under the jurisdiction of the United States. The Coast Guard issued an interim rule on September 29, 2008, which imposed new limitations on the discharge of DCR, mandated recordkeeping and reporting requirements, and which encouraged carriers to adopt voluntary control measures to reduce DCR discharge. As described above, evaluation of the current Proposed Action will "tier off" of the Phase I Final EIS conducted for the interim rule, further developing and analyzing the effectiveness and costs of DCR control measures.

The Proposed Action will consider data collected to address gaps identified in the Phase I Final EIS and what changes, if any, should be made to the interim rule governing DCR discharges. The Proposed Action will continue to balance commercial and environmental interests when looking at impacts resulting from potential mandatory use of DCR control measures, the adjustment of the geographical boundaries within which discharges are currently allowed, or other regulatory changes. This Tiered Final EIS fulfills NEPA's statutorily mandated requirement to conduct an "environmental assessment" in support of the Proposed Action.

The authority for the Proposed Action is the Coast Guard and Maritime Transportation Act (CGMTA) of 2004, Public Law 108-293, § 623. The Act grants the Commandant of the Coast Guard, notwithstanding any other law, the permanent authority to promulgate regulations governing the discharge of DCR on the Great Lakes. In exercising its authority under Public Law 108-293, the Coast Guard seeks to optimize the outcome for maritime safety, protection of natural resources, and maritime mobility, all of which, along with maritime security and national defense, are Coast Guard strategic goals. These objectives will be used to identify alternatives that meet the purpose and need.

1.5 Public Involvement (for Tiered EIS)

With the publication of the interim rule in the *Federal Register* on September 29, 2008 (73 FR 56492), the Coast Guard requested public comment "…on the need for and feasibility of additional conditions that might be imposed on discharges in the future, such as mandatory use of control measures, or further adjustments to the areas where discharges are allowed or prohibited." Three months later, on December 29, 2008, the Coast Guard announced its intent to prepare a new EIS (Appendix B) in support of a final rule that could modify the interim rule (73 FR 79496). The *Federal Register* notice requested public comments, which would be used to determine the scope of issues in the Tiered EIS. The notice also provided information on the January 28, 2009, scoping meeting in Chicago, Illinois, and requested comments on or before March 30, 2009. Prior opportunities for public input into DCR management alternatives and the scope of the Phase I Final EIS analysis were described in Sections 1.6 and 1.7 of that document. Comments received on the Phase I Draft EIS were summarized in Section 1.2 of the Phase I Final EIS.

Public input received following publication of the interim rule, during the January 2009 scoping meeting, and throughout the scoping comment period assisted the Coast Guard in determining the scope of the Tiered EIS, identifying any new issues, and potentially providing input on new or modified alternatives that should be considered.

During the comment period, comments were received from 19 sources, including five State agencies (representing four States, with one State providing comments from two separate agencies, and one agency submitting multiple comments), four industry groups, two non-industry groups, one Indian Tribal group, and seven individuals. Comments fell into five categories: support or opposition for the rule, regulatory issues, environmental issues, DCR control strategies, and procedural issues. In the first category, three commenters expressed support for the interim rule or DCR discharges and eight commenters expressed opposition.

From a regulatory perspective, three State agency commenters said the interim rule is inconsistent with their State laws and coastal zone management plans and two said the interim rule is at odds with the EPA's Vessel General Permit (VGP) for discharges incidental to the normal operation of vessels. One commenter questioned the Coast Guard's authority to regulate DCR discharges in the Great Lakes and another commented on the need for consistent regulatory approaches between the United States and Canada.

From an environmental perspective, two State agency commenters said that DCR discharges are harmful because they provide favorable substrate for invasive or exotic species, and two commenters disagreed with the characterization of DCR as non-toxic and non-hazardous. Others asked for an evaluation of DCR controls affecting special protected areas, protection of additional areas, and other studies.

One commenter asked for specific technological and procedural measures to control DCR, another commenter offered information about specific control measures, and others recommended requiring best management practices to minimize DCR discharges and the regulation of shoreside facilities, since vessels have no control over shoreside operations.

From a procedural perspective, commenters asked for an extension of the comment period, and another recommended relying on States to provide information about port-based DCR control measures. Two commenters asked that reporting requirements be removed, two recommended changes to the recordkeeping form, and one asked for a review of DCR control measures every three years.

A summary table of the comments with Coast Guard responses is provided in Appendix B. Where the same or similar comments, for example, a no-discharge approach to DCR management, were received previously for the Phase I Draft EIS and during scoping for the Tiered EIS, the more detailed response to comments provided in the Phase I Final EIS was referenced. Individual comment letters and the transcript from the January 2009 scoping meeting are available on the public docket, accessible at http://www.regulations.gov/#!docketDetail;rpp=10;po=0;D=USCG-2004-19621.

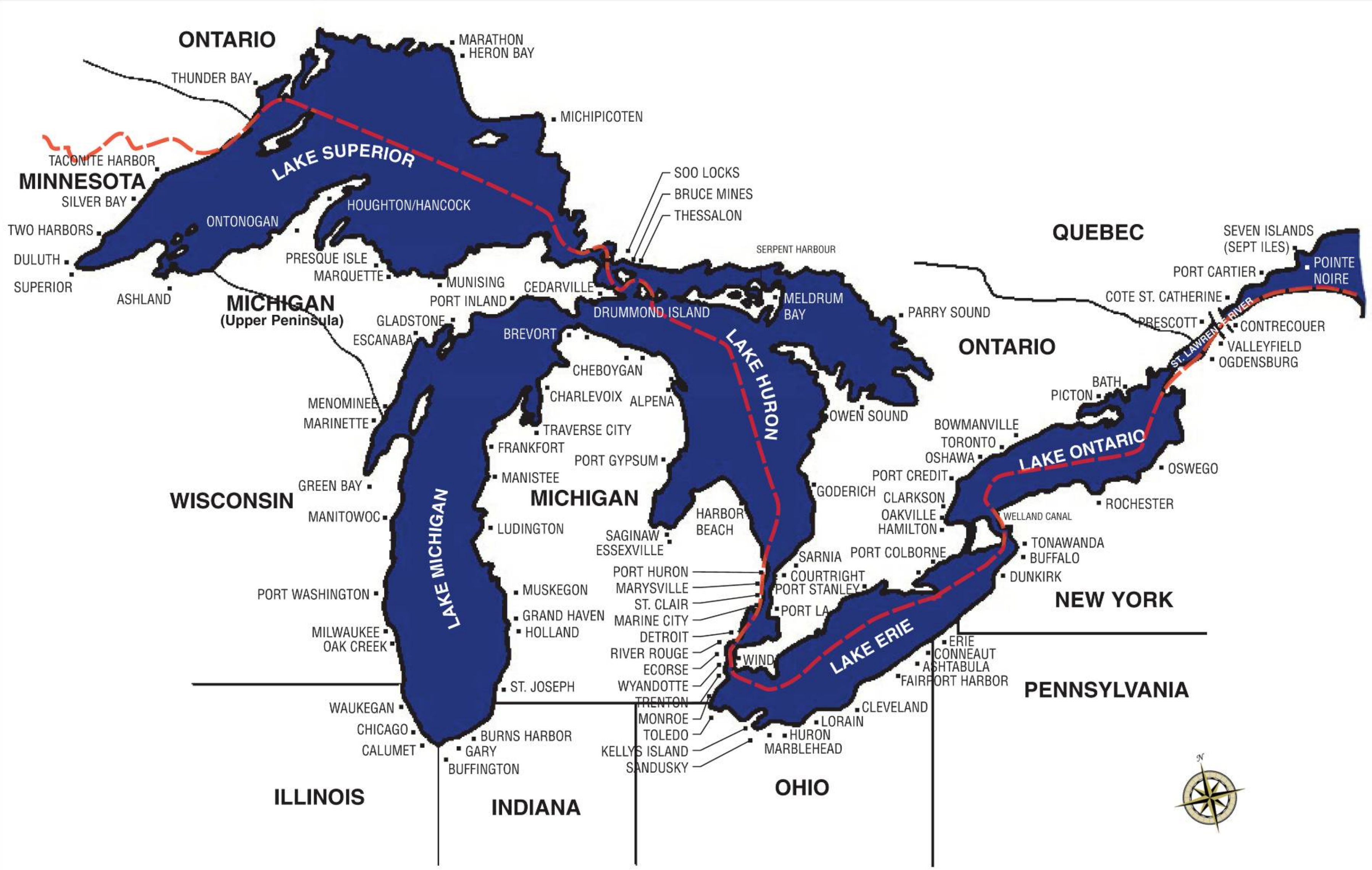


FIGURE 1-1
Study Area

Sources: Lake Carriers' Association (2004), GoogleEarth (2007)

Canada-United States International Border

ES091709172941WDC

CH2MHILL

1.6 Scope and Organization of Tiered Final EIS

The study area for the Phase I Final and Tiered EISs is the same (Figure 1-1). The Tiered EIS is organized similarly to the Phase I Final EIS, with the Tiered EIS summarizing and referencing detailed information from the Phase I Final EIS. Chapter 2 describes alternatives originally considered and evaluated in Phase I and modified alternatives considered in this EIS as a result of additional data collected by vessels and the Coast Guard. Existing conditions are described in Chapter 3, with information on sediment quality, water quality, and biological resources from the Phase I Final EIS summarized. Socioeconomic resources and the bulk dry cargo carrier industry are described in greater depth, in support of additional economic impact analysis. Chapter 4 evaluates the effect of the alternatives on potentially affected resources areas, mitigation that was considered, and required permits, licenses, and approvals related to the alternatives. Chapter 5 compares alternatives.

1.7 Great Lakes Dry Cargo Shipping Industry Description

1.7.1 Summary Description of Industry and Practices

In support of DCR rulemaking, the Coast Guard examined and documented relevant aspects of the dry cargo shipping industry on several occasions (U.S. Coast Guard, 2002, 2006, 2008). These examinations were based in part on shipping data through the 2008 shipping season, and the summary of the industry presented below is based on this information.

During the 2006 shipping season, which represents a long-term average of dry cargo operations, 55 U.S. vessels and 70 Canadian vessels carrying bulk dry cargoes operated on the Great Lakes (Table 1-3). Non-self-propelled barges that are not part of an integrated tug-and-barge unit are not covered by the Proposed Action and thus are not part of this EIS or the data analysis in this EIS. Four companies handle most (75 percent) Great Lakes U.S. vessel bulk dry cargo shipments: American Steamship Company, Great Lakes Fleet, Interlake Steamship Company, and Lower Lakes Towing and Lower Lakes Transportation. Similarly, four companies handle most (80 percent) Canadian-vessel shipments: Algoma Central Corp., Canada Steamship Company, Groupe Desgagnes, Inc., and Upper Lakes Group, Inc.

TABLE 1-3
Active Great Lakes Bulk Dry Cargo Carriers from Phase I Final EIS

Company	Vessels	Note
U.S. Companies		
American Steamship Company	18	—
Central Marine Logistics	3	—
Great Lakes Fleet	8	—
Hannah Marine Corps	2	—
Inland Lakes Management	1	Five vessels in long-term lay-up not included in count. Vessels may sail if demand for cement increases
Interlake Steamship Company	9	One vessel in long-term lay-up not included in count
Keystone Lakes Shipping	1	—

TABLE 1-3
Active Great Lakes Bulk Dry Cargo Carriers from Phase I Final EIS

Company	Vessels	Note
KK Integrated Shipping, LLC/KK Integrated Logistics	2	One vessel in long-term lay-up not included in count
LaFarge North America Inc.	2	—
Lower Lakes Towing/Lower Lakes Transportation	7	Lower Lakes Towing and Lower Lakes Transport is a Canadian company with U.S. affiliates
Upper Lakes Towing, Inc.	1	—
Van Enkevort Tug and Barge, Inc.	1	—
Total U.S. Vessels	55	—
Canadian Companies		
Algoma Central Corp.	17	Two vessels in long-term lay-up not included in count
Canada Steamship Company	14	—
Great Lakes Transport Ltd.	1	—
Groupe Desgagnes, Inc.	8	One vessel in long-term lay-up, and two vessels trading on the St. Lawrence River not included in count
K-Sea Canada Corp.	1	—
Lower Lakes Towing/Lower Lakes Transportation	4	Four of the 11 vessels owned by the company are operated by the Canadian branch of the company
McKeil Marine Ltd.	2	—
Pere Marquette Shipping	1	—
St. Marys Cement	2	—
Upper Lakes Group, Inc.	17	Two vessels in long-term lay-up and two in permanent lay-up not included in count
Voyageur Marine Transport Ltd.	3	—
Total Canadian Vessels	70	—
Total U.S. and Canadian Vessels	125	—

Sources: LeLievre (2006); www.boatnerd.com (2007); Kirkbride (2007).

Based on shipping operations (from 2000 to 2008) and on information obtained from the Lake Carriers' Association (LCA, 2009), U.S. vessels operate out of roughly 70 U.S. ports in Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York, with the greatest number of ports, 40, in Michigan. Canadian vessels operate out of 35 ports in Ontario and Quebec, with most of those ports in Ontario.

Most Great Lakes carriers transporting bulk dry cargoes move the cargo between Great Lakes ports (U.S. Coast Guard, 2002). Taconite (primarily in the form of pellets), coal, and limestone are the primary commodities transported, with cement, salt, sand, and grain transported to lesser extents (Table 1-4), over the period from 2000 to 2008. On average, 92 percent of the U.S. vessel bulk dry cargo is composed of these three primary cargoes; Canadian vessels have a similar cargo composition (U.S. Coast Guard, 2002).

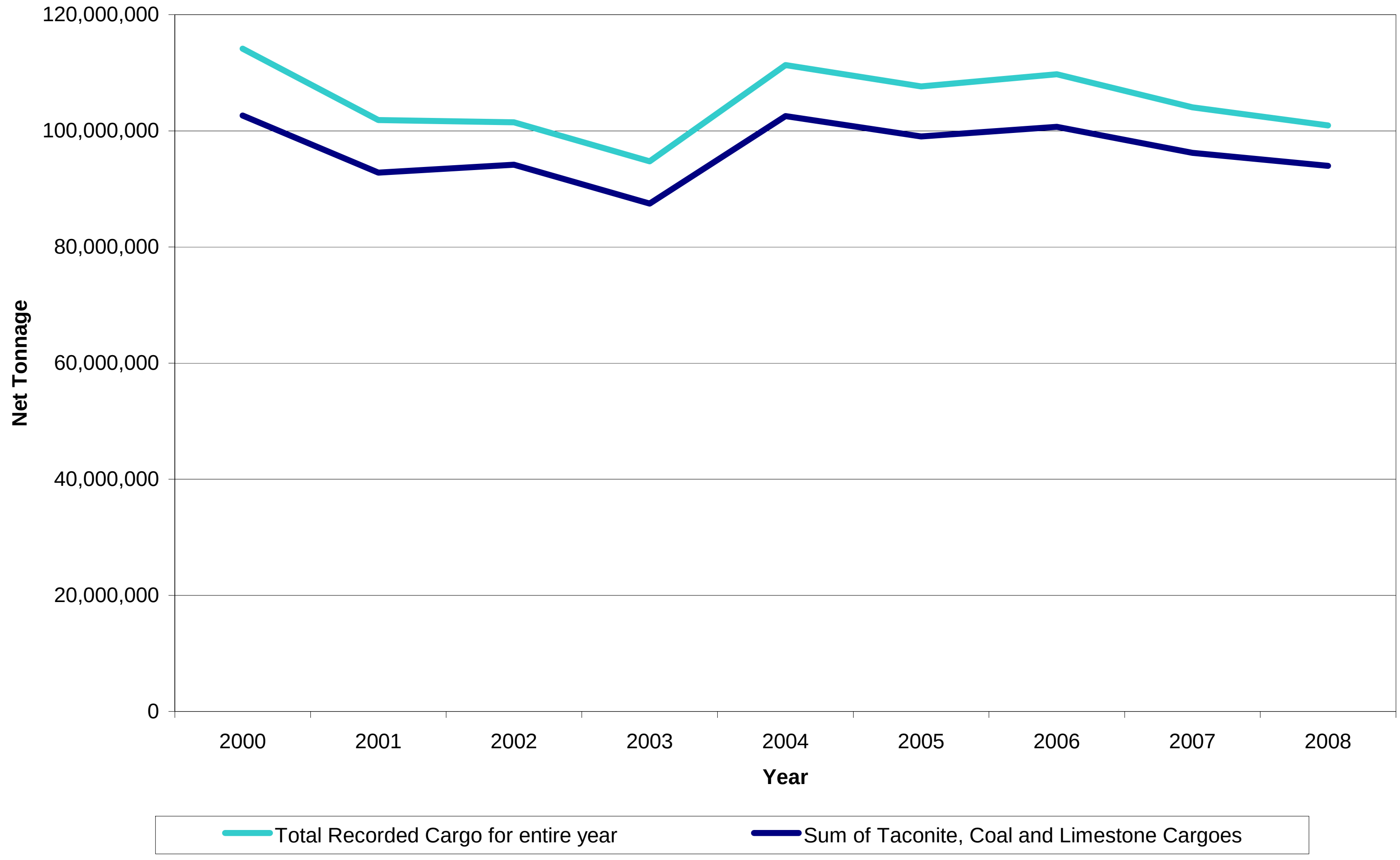
TABLE 1-4
Carriage on the Great Lakes: 2000–2008 Shipping Seasons (U.S. Vessels, to Nearest Thousand Tons)

Commodity	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average 2000–2008
Taconite	60,333	46,925	48,195	43,016	51,202	46,572	48,972	47,206	47,223	48,849
Direct shipments	54,587	43,830	45,861	41,344	48,265	43,885	45,850	45,050	45,330	46,000
Trans-shipments[a]	5,746	3,095	2,334	1,673	2,936	2,688	3,122	2,157	1,894	2,849
Coal[b]	20,760	21,959	21,744	21,879	24,416	27,207	25,333	25,171	24,972	23,716
Limestone	27,288	26,989	26,554	24,239	29,861	27,936	29,489	25,966	23,632	26,884
Subtotal taconite, coal, and limestone	102,635	92,778	94,159	87,462	102,543	99,027	100,673	96,186	93,933	96,600
Taconite, coal, and limestone (%)	90	91	93	92	92	92	92	93	93	92
Cement	4,145	4,137	3,818	3,851	3,965	3,893	4,025	3,602	3,294	3,859
Salt	838	876	587	945	1,032	1,188	1,127	1,241	1,225	1,007
Sand	427	625	231	500	489	462	429	449	359	441
Grain	352	351	329	312	368	403	357	405	248	347
Totals	114,143	101,86	101,459	94,744	111,334	107,660	109,733	104,041	100,953	105,103

Source: LCA (2007, 2009).
[a]Taconite trans-shipments are carried within Cleveland Harbor.
[b]Coal carriage includes Lake Superior, Lake Michigan, and Lake Erie.

750

FIGURE 1-2
Cargo Hauled on the Great Lakes by U.S. Vessels
Source: LCA (2007, 2009).



The three primary cargoes are shipped among several major U.S. ports (U.S. Coast Guard, 2006):

Taconite. Iron ore is mined in Minnesota and Michigan, and processed taconite pellets are transported from Duluth, Silver Bay, and Two Harbors, Minnesota; Superior, Wisconsin; and Marquette and Escanaba, Michigan; and shipped to ports near major U.S. steel mills (for example, Cleveland, Lorain, and Toledo, Ohio; Gary and Indiana Harbor, Indiana).

Coal. Eastern and western coals are shipped through the Great Lakes. Typical shipping origination points in the U.S. are Superior, Wisconsin; Calumet, Illinois; and Ashtabula, Toledo, and Sandusky, Ohio. Coal is received at a large number of ports (over 30) in Minnesota, Wisconsin, and Michigan.

Limestone. The Great Lakes region is a large supplier of limestone, with the largest quarry in the world at Rogers City, Michigan. Limestone is shipped from a number of Michigan ports and other ports throughout the Great Lakes.

Of the Canadian ports, taconite is shipped primarily from Quebec (Port Cartier, Sept Iles, and Pointe Noire), limestone from Ontario (Thessalon, Meldrum Bay, and Bruce Mines), and coal from Thunder Bay, Ontario.

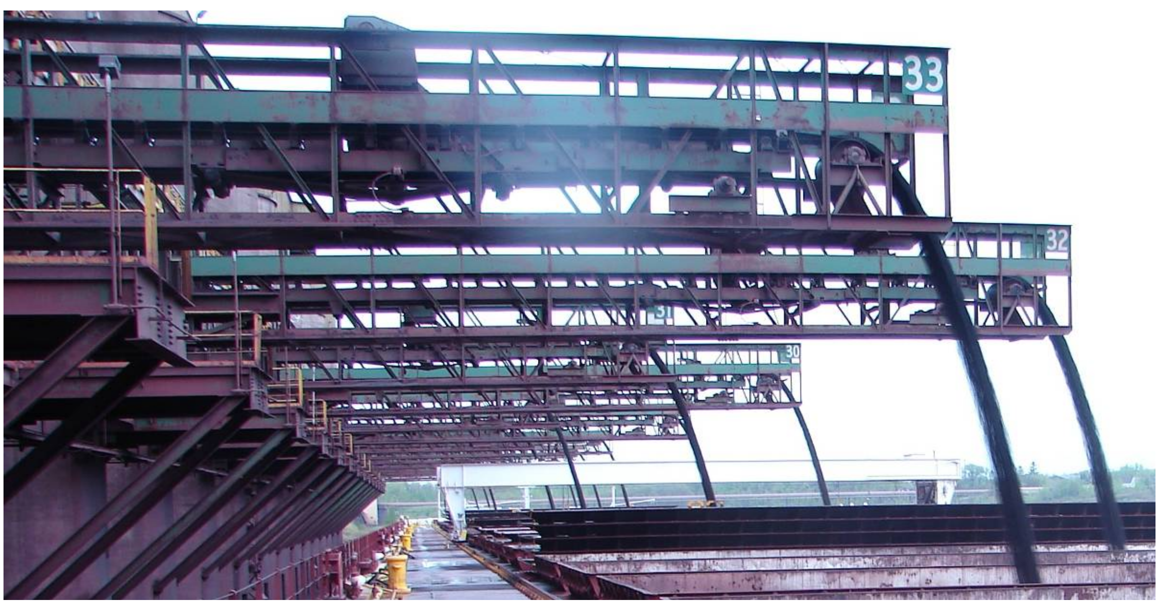
In general, U.S. vessels transported decreased quantities of bulk dry cargoes on the Great Lakes from 2000 to 2003, with an upturn in 2004 (Figure 1-2). Transport quantities in 2005 and 2006 showed small downturns from 2004 but have remained above the low points observed from 2001 through 2003. From 2005 to 2006, the quantity of bulk dry cargoes transported increased by 2 percent. While coal and limestone transports were higher in 2007 than in 2000, the overall decreased transport of taconite, coal, and limestone over the 7-year period is attributed to a decline in the steel industry and dropping demand for raw materials. Annual shipping tonnages compiled by the Lake Carriers' Association showed that the 2009 shipping tonnages of all commodities was 33 percent lower than the previous 5-year average due to a decrease in demand for commodities.

1.7.2 Bulk Dry Cargo Handling

Over the past several decades, U.S. bulk dry cargo carrier operations have become increasingly efficient, with larger, more complex vessels capable of transporting a variety of cargoes and rapidly unloading as a result of self-unloading conveyor systems. Similarly, most shoreside loading facilities have motorized conveyor belt systems that quickly transfer bulk dry cargo from shoreside storage areas to vessel cargo holds, and nearly the entire U.S. fleet of bulk dry cargo carriers can load and unload with little shoreside assistance (U.S. Coast Guard, 2006). As loading and unloading operations have become increasingly automated, U.S. crew sizes have consequently decreased, and operating schedules have tightened so that port time has been reduced to the greatest extent possible. Although the pace of loading or unloading varies with the conveyor loading mechanism, vessel size, cargo type, and port facilities, a self-unloading vessel can be unloaded in 8 to 20 hours.

FIGURE 1-3
Single Conveyor with Telescoping Loading Chute Typical of Coal-Loading Operations

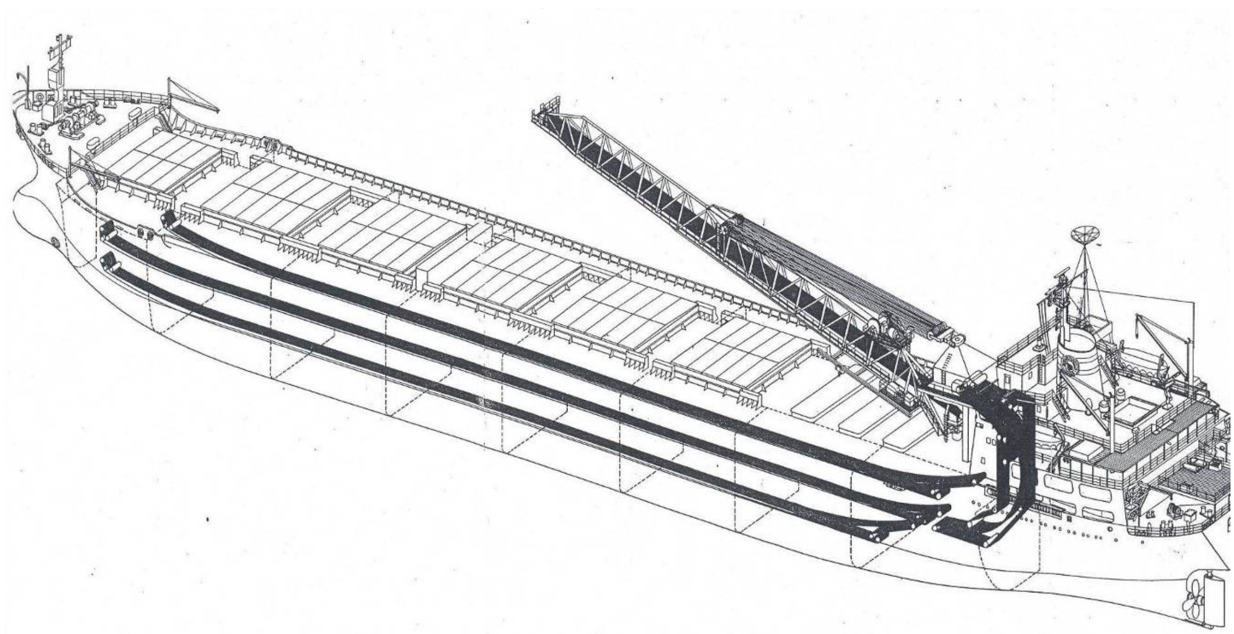
FIGURE 1-4
Multiple-Horizontal-Conveyor Loading Mechanism Typical of Taconite-Loading Operations



During loading, conveyor belts or chutes transport bulk dry cargo from shoreside facility to vessel. Depending on the type of conveyance system, the conveyor belt may be stationary—requiring the vessel to shift position to allow the cargo to be loaded in individual holds—or the conveyor belt may be shifted from hold to hold. The cargo can be deposited in the hold either through a loading chute (typical for coal) or by free fall from the conveyor into the hold (typical for taconite and limestone). Examples of these loading mechanisms are shown in Figures 1-3 and 1-4.

A self-unloading vessel has a conveyor belt that passes through the vessel's tunnel underneath the cargo holds and runs the length of the vessel (Figures 1-5 and 1-6).

FIGURE 1-5
Self-Unloading System aboard a Typical Great Lakes Vessel
Figure courtesy of Lake Carriers' Association.

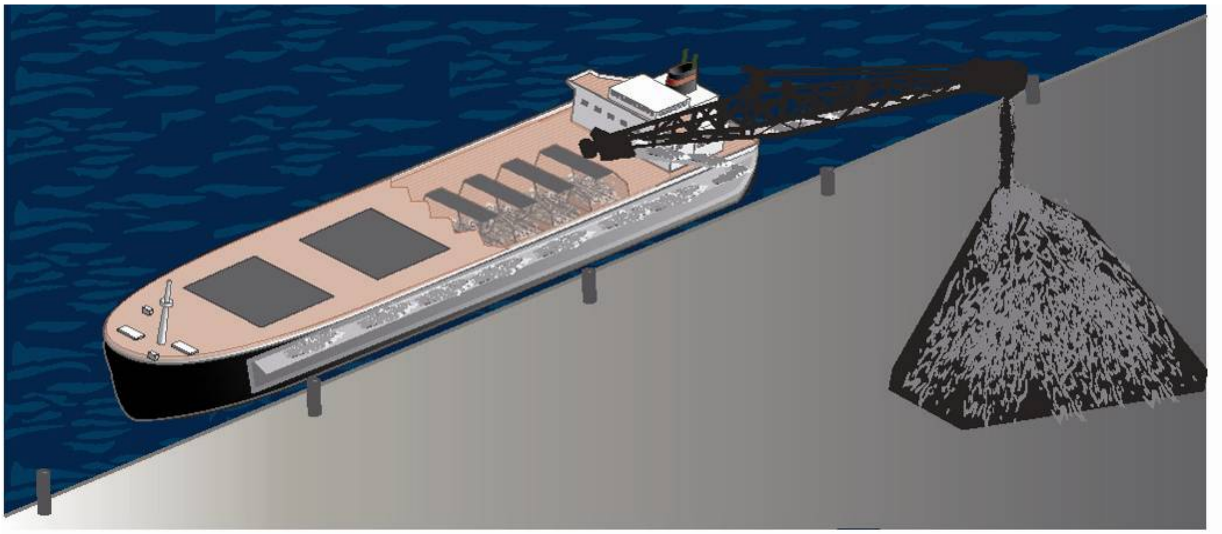


Gates at the bottom of each hold release cargo to the conveyor belt. Adjusting the gate opening controls cargo flows onto the conveyor belt. In general, faster unloading leads to a higher risk of DCR in the cargo tunnel. Often, an automated system monitors the amount of cargo being loaded on the belt and signals the operator when the cargo load approaches or exceeds a predetermined threshold. If a threshold is approached, adjustments can be made to optimize the unloading rate and reduce residue.

Washing and discharging DCR into the Great Lakes has been a standard practice for more than 75 years.

When the cargo reaches the end of the unloading belt, an additional conveyor belt(s) or equivalent equipment transfers it upward to the deck. On deck, the cargo is transferred to the boom conveyor belt, and the boom (commonly 250 feet long) is swung over the side of the vessel so that the cargo can be deposited into a hopper or directly on shore.

FIGURE 1-6
Representation of Cargo Unloading



During loading and unloading, relatively small quantities of cargo may fall onto the deck or into the tunnels under the vessel's deck. DCR on the deck and in cargo tunnel areas is typically washed with high-pressure fire hoses and discharged into the lake. Alternatively, DCR on the deck may be manually shoveled into the holds, and DCR in the cargo tunnel areas can be shoveled onto the conveyor belts there, schedule permitting. Washing and subsequent discharge of deck and tunnel DCR into the Great Lakes has been a standard practice for more than 75 years (U.S. Coast Guard, 2006).

TABLE 1-5
Comparison of Estimated DCR Discharge Relative to Total Transported Cargo: 2002 Shipping Season
U.S. and Canadian Vessels (in Tons)

	Shipping Season	Total	Taconite	Coal	Limestone
U.S. vessel discharges	2002[a]	531	215	119	197
	2004	555	326	109	114
Canadian vessel discharges	2002[b]	276	82	124	22
Total discharged[a, b]	2002	807	297	243	219
Total transported	2002	1.66E+08	5.59E+07	4.38E+07	3.71E+07
Estimated total percent discharged		0.0005	0.0005	0.0006	0.0006

Source: U.S. Coast Guard (2002, 2006).
[a]From vessel logbooks for approximately 67 percent of U.S. vessels adjusted to estimate 100 percent of vessels by increasing the value by 33 percent.
[b]From vessel logbooks for approximately 50 percent of Canadian vessels in U.S. waters adjusted to estimate 100 percent of vessels by increasing the value by 50 percent.

The Coast Guard (2002, 2006) evaluated DCR discharges voluntarily reported by the shipping industry (Table 1-5). The voluntarily reported DCR varied between the two shipping seasons for U.S. vessels (the only vessels with data available for both periods), with taconite greater in 2004 and limestone greater in 2002. Coal and total DCR were similar in the two years. The reported DCR was consistently 0.0005 to 0.0006 percent of the entire cargo transported.

1.7.3 Dry Cargo Residue Discharge Control Measures

1.7.3.1 Introduction

The Great Lakes shipping industry historically has undertaken measures to prevent, reduce, and control the discharge of DCR during dry-cargo-handling procedures in order to minimize waste and environmental effects, maintain safety aboard vessels, and maintain equipment.

Since 1993, when the Coast Guard issued the IEP for Dry Cargo Residue, the shipping industry has demonstrated increased awareness and attention to DCR discharge control. This awareness has been reinforced since September 2008, when the Coast Guard's DCR interim rule calling for the shipping industry to implement additional voluntary DCR discharge control and mandatory reporting measures, including the use of a DCR reporting form, took effect. (See Appendix C for a copy of the form.)

To better understand which control measures are in place and effective in preventing or reducing the discharge of DCR, the Coast Guard conducted an extensive examination of DCR practices and control measures, in 2008 and 2009. The examination consisted of assembling and evaluating loading and unloading information taken from the DCR reporting forms required by the 2008 interim rule of each Great Lakes dry cargo carrier operating in U.S. waters. In addition, the Coast Guard conducted detailed observations and measurements of DCR loading and unloading events during the 2009 shipping season.

The objectives of the DCR reporting form and observation program were the following:

- Catalog the variety, heterogeneity, and frequency of DCR control measures (physical infrastructure and procedural) among Great Lakes carriers and shoreside loading facilities
- Evaluate the effectiveness of individual control measures in reducing DCR volume as a measure of their effectiveness in reducing DCR discharges
- Estimate the typical and extreme volumes of DCR volumes resulting from loading and unloading events
- Identify factors other than physical infrastructure measures that influence DCR volumes and ultimately DCR discharges to the Great Lakes
- Assess the consistency and usefulness of DCR records completed by vessel owners, agents, crew, and operators
- Develop an inventory of U.S., Canadian, and foreign (non-Canadian) vessels carrying bulk dry cargo on the Great Lakes.

The detailed and complete methods and results of the DCR reporting form evaluations and observation program have been reported in technical memoranda (Appendices C and D).

The methods and general findings for each are summarized in the subsections below. The summaries are followed by an overall discussion of DCR volumes and control measures.

1.7.3.2 DCR Reporting Form Evaluation

Several hundred DCR reporting forms, representing over 3,000[2] loading and unloading events for the period September 29, 2008 to January 15, 2009, were received by the Coast Guard from Great Lakes dry cargo carriers. Forms reporting approximately 2,500 additional individual loading and unloading events for the period January 16, 2009 through July 15, 2009, were also submitted by Great Lakes dry cargo carriers.

DCR reporting forms were used by vessels' crews to document the DCR control measures used and to estimate the DCR quantity discharged for every loading and unloading event during the reporting period.

The data from the DCR reporting forms were reviewed, entered into a database, evaluated, and documented in technical memoranda. (See Appendix C, "Dry Cargo Residue Reporting Form Evaluation for Shipping Activity from Sept. 29, 2008, to Jan. 15, 2009" and "Dry Cargo Residue Reporting Form Evaluation for Shipping Activity from Jan. 16, 2009 to July 15, 2009").

Unfortunately, the data submitted reflect the difficulty in estimating DCR quantities (see Section 1.7.3.3, which describes the Coast Guard's DCR observation program) and the inconsistencies and misunderstandings often associated with a new reporting requirement. Although approximately 2,500 events were reported for the period Sept. 29, 2008, to Jan. 15, 2009, for all cargoes shipped, only 1,072 of these events (1) included DCR volume estimates and thus were usable in the analysis of data *and* (2) were for the three primary cargoes (coal, limestone, and taconite). Data from the first two quarters of 2009 reflected some improvement, but the quality of the data contained in the records limits its use.

There are numerous conditions that contribute to variations in estimates of DCR quantities. For example, it is inherently difficult to accurately and consistently estimate the quantity of DCR given the size and configuration of the vessel area where DCR accumulates and the variability from area to area. In addition to real differences in DCR among vessels resulting from varying conditions and differing degrees of attention to DCR discharge control, the lack of experience by vessels' crews, lack of training in using the reporting form, and a lack of understanding of the reporting program resulted in extremely wide ranges in DCR quantity reporting and, in many cases, incorrect DCR discharge control measures reported.

For example, in every category (i.e., loading and unloading, all cargo types), the estimated quantities for several events were reported as zero DCR discharge volume. There were also extremely high values; for example, one taconite-unloading event was reported as being over 110 tons, compared to a median of 0.3 ton and a mean of 2 tons (367 times greater than the median). Reported maximums in other categories were generally 10 to 100 times the median, which was a much wider range than expected. This range is also not in accord with the data gathered during DCR loading and unloading observations conducted from May through July 2009 (Appendix D).The extreme values and extremely wide range of DCR

---

[2] Forms for approximately 2,500 events were submitted initially; forms for an additional 500 events, submitted late, were not included in the analysis reported in Appendix C.

discharge volume estimates reflect the inherent difficulty in estimating DCR volumes, a range of attentiveness to DCR discharge control by the vessels' and shoreside loading facilities' crews and employees, and a lack of understanding and accuracy in estimating. Thus the strictly quantitative usability of the data is limited. However, as discussed below, when viewed in light of other DCR discharge volume estimates, the data add to the general understanding of DCR handling and control of discharge volumes.

Similar limitations and an apparent lack of knowledge or understanding of control measures by those completing the form were evident for the reporting of DCR discharge control measures. For example, structural control measures, such as skirts for conveyor belts, are either present or not present on any given vessel or shoreside loading facility. Such equipment is permanently affixed and is not removed for some loading or unloading events and left in place for others. However, such measures were reported as absent for some events and present for others on the DCR reporting form for the same vessel or shoreside loading facility.

There were also quantitative inconsistencies with control measure reporting, which indicate a lack of accuracy in the DCR reporting forms. Casual observations, general Coast Guard knowledge of Great Lakes shipping, discussions with industry personnel, engineering judgment—subjective conclusions reached on the basis of professional experience— and common sense all indicate that DCR discharge control measures in general reduce DCR volume. The degree of reduction might be highly dependent on conditions and operations of a control measure, on variability in cargo, and even on weather, but with hundreds of records one would expect to see some effect of control measures reducing DCR discharge volume. This was not the case with the 2008–2009 DCR reporting form data. The relationship between reported use of a control measure and the estimated volume of DCR was statistically tested using analysis of variance (ANOVA) techniques for the first quarter of reported data (Appendix C). The tests were designed to determine the effectiveness of the reported vessel and shoreside facility control measures. Based on the tests, there was no statistically significant relationship between a given control measure and the volume of DCR for most of the cases. When there was a significant relationship, half the time the control measure was correlated with more, rather than less, DCR.

Events in which multiple specific control measures are used have mean DCR volumes well below events without these measures.

Given the inconsistencies with the DCR reporting form data summarized above and presented in detail in Appendix C, the use of the information for quantitatively based analysis is limited. However, the DCR volume estimates from the DCR reporting form are very helpful when viewed in combination with other estimates. Also, even though there is no significant statistical relationship between control measures and reduced DCR discharge volume as reported by the vessels, information in the DCR reporting form data supports the concept of control measures reducing DCR discharge volume. Events employing multiple specific control measures have a mean DCR discharge volume well below events without these measures, and these same control measures have lower mean DCR discharge volumes for multiple cargoes. These control measures include the following:

- Enclosed conveyor belts
- Loading chutes
- Stopping the conveyor while vessel or loader is shifting
- Belt scrapers
- Tarps
- Brooms and shovels
- Troughed conveyors

The events employing these measures generally had mean DCR discharge volumes at least 50 percent less than events not employing the measures. These are also measures that based on the large number of observations of loading and unloading events (Appendix D) and engineering judgment should be the most effective.

1.7.3.3 Dry Cargo Loading and Unloading Observations

An extensive program of observing and evaluating the procedures for handling bulk dry cargo and DCR was completed in the spring and summer of 2009. The object of the program was to examine dry-cargo-handling and DCR-handling procedures and equipment, provide a basis of comparison for the information from the DCR reporting form, assess effectiveness of various DCR discharge control measures, and quantify DCR under various conditions. Over the course of more than a month, the loading, unloading, and collecting of DCR were observed for 30 events. The DCR discharge control measures present and in use were also recorded for these 30 events plus one additional facility where DCR was not quantified because no vessels were scheduled to load during the visit, but DCR control measures at the facility were documented. The full description of the program and results were documented in a technical memorandum (Appendix D).

As expected from the wide range of shoreside dry cargo equipment, cargo types, and equipment, there was substantial variability in handling procedures. The observations revealed variability in crews’ DCR-volume-estimating procedures and degrees of accuracy in estimating volume as compared with those determined from the DCR reporting form evaluation. But equally important, the observations identified real and substantial differences in DCR volume generated by different vessels and shoreside loading facilities. These real differences resulted not only from the discharge control measures used and their conditions but, perhaps more importantly, from the varying degree of commitment to DCR control exhibited by the different vessels and shoreside loading facilities. The variability in DCR volume resulted from primarily only a few factors, summarized below, which had the greatest influence on DCR volume for most events observed. Nearly all vessels and shoreside facilities observed have the equipment necessary to minimize DCR discharges, but not all maintained or operated the equipment to the same degree of effectiveness.

Nearly all vessels and shoreside facilities observed had the equipment necessary to minimize DCR, but not all vessels and facilities maintained or operated the equipment to the same degree of effectiveness.

Several of the vessels and a few shoreside facilities observed took steps to actively reduce DCR. Such activities included proper adjustment of belt scrapers so that returning conveyor belts did not deposit DCR on the deck or in the tunnel; careful operation of cargo-hold gates so that large, uncontrolled volumes of dry cargo did not overload the conveyor belt also limited DCR volume; and collecting and depositing DCR in the hold or on the tunnel conveyor belt by crew members when they were not actively engaged in other tasks was another highly effective DCR control method. Several vessels had adapted the tunnel sump pump (used to pump collected DCR washwater overboard) so that it could discharge to the conveyor belt during unloading, thus minimizing the sump discharge, and associated DCR, into the Great Lakes once the vessel was underway. Vessels that engaged in these and similar measures (Appendix D) produced substantially lower volumes of DCR on their decks and in their tunnels, thus reducing the DCR discharged to the surface water. In contrast, vessels and shoreside loading facilities that did not actively use or adequately maintain available DCR discharge control measures produced much larger DCR volumes. For example, proper conveyor belt alignment was shown to reduce DCR by 2 to 30 times, and in one case, a significantly misaligned conveyor belt caused more than 400 times more DCR than one properly aligned (Appendix D).

Generally, over 90% of DCR associated with unloading was observed below deck and involved the unloading tunnel.

The observation program also revealed significant differences between vessel loading and unloading events. DCR produced by loading is generated typically on a vessel’s deck, whereas generally greater than 90 percent of the unloading DCR was observed in the tunnel and below-deck transfer locations. DCR generated by loading is primarily the result of shoreside facility equipment, operation, and maintenance, and a vessel’s crew has little control over these factors. The exception is collecting deck DCR and depositing it in the vessel cargo hold during the loading operation, which is within the vessel’s control. Communication between the vessel and the shoreside unloading facility can also reduce DCR, particularly by preventing extreme events.

In contrast, DCR volume during unloading is controlled largely by equipment and activities onboard the vessel. One exception is the method of receiving cargo on shore: at locations where the cargo is stockpiled, there is much more DCR generated on the vessel than at facilities where the cargo is fed into a hopper. This is because the unloading rate is controlled by the capacity of the hopper, which is generally less than the vessel’s unloading capacity, and at slower unloading rates less cargo falls off the vessel’s unloading conveyor belt and at transfer locations. At shoreside facilities where the cargo is stockpiled, the vessel unloading capacity is not restricted, and at the higher unloading rates more cargo falls off the conveyor and at transfer locations. Of the 11 shoreside facilities receiving cargo from vessels visited during the observation program three had hoppers.

The greatest difference between loading and unloading events is the volume of DCR. Depending on cargo, the DCR volume from unloading events was about two to 10 times greater than the DCR volume from loading events. The vast majority of unloading DCR is generated in the tunnel when cargo falls off the conveyor belt as a result of actions such as cargo hold gate operation, operation and maintenance of equipment such as belt scrapers, conveyor belt skirts, and other operational procedures such as using water to wash cargo holds and suppress dust.

The observation program provided an opportunity to compare information on the DCR reporting form to actual measurements of DCR volume for the loading and unloading events observed (Section 2.3, Appendix D). There is substantial variation in the volume estimates between the vessel records and the observations made by the Coast Guard for many events, which is likely due to the methods used by the vessel crew to estimate volume. For the observation program, DCR from representative areas of the deck or tunnel was actually collected and measured and the results extrapolated to the entire vessel. In contrast, the method generally employed by vessels to complete the DCR reporting form was a qualitative, observation-only estimate.

DCR volume from unloading events was about 2 to 10 times greater than volume from loading events.

Even with the methodological differences for loading events, there was relative consistency between the estimated median volumes from the vessel records and the median volumes from direct observations (30 percent or less difference), although there was more variability in the estimates of individual loading events. Of the 11 observed loading events with corresponding DCR reporting forms, observation estimates were higher for seven and lower for four. The individual records for coal were generally similar between observations and vessel records but varied by two and three times for taconite and limestone, respectively. A vessel's recorded median DCR volume for limestone was about two times greater than the estimate from direct observations, whereas the taconite direct observations' estimates were about two times greater than the vessel records.

The variation in estimates between observations and the DCR reporting form were much greater for unloading than for loading, with the DCR volumes for unloading greater than those for loading for most events. The estimated median DCR volumes based on the direct observations were higher than the vessel records for all cargoes, with the median observed volumes 4.5, 5, and 1.3 times higher than the vessel records for coal, limestone, and taconite, respectively. There was greater similarity in taconite DCR estimates, with median vessel record estimates roughly double the median direct observation estimates, and the vessel record volumes higher for half the events.

For several coal and limestone unloading events, vessel record estimates are similar to the observation estimates for the deck alone, and the estimates entered on the DCR reporting forms seem to ignore the DCR in the tunnel. During the observations, many crew members that completed the DCR reporting form stated that the tunnel was not inspected to estimate the DCR volume, and many indicated they had little knowledge or experience of tunnel-washing operations. The mate typically recorded a value provided by the tunnel crew, a value based on prior experience, or a value based on the duration of tunnel washdown. Thus, for at least some vessels, it appears the tunnel DCR was either ignored or inaccurately estimated.

Comparisons of observations and DCR reporting form estimations for events where there were both also revealed substantial inconsistencies in the DCR discharge control measures reported. Significant differences in control measures used by the shoreside facility and vessels were noted between the vessel reporting forms and the observations. This could simply be because the vessel incorrectly recorded a nonexistent control measure or did not record an existing control measure. Approximately 20 to 30 percent of the control measures were either reported on the DCR reporting form and not observed or observed and not reported on the DCR reporting form (Appendix D, Section 2.3). This inconsistency, along with volume-estimating inaccuracies, could be a major factor in explaining the lack of statistical correlation between control measures reported on DCR reporting forms and DCR volumes, as discussed in Section 1.7.3.2.

1.7.3.4 DCR Quantities

There is substantial variability in estimates of DCR discharge volumes from individual vessels, which is expected from the different DCR management practices and methods used to estimate the volume. However, when all the estimates are viewed together, there are important conclusions about the expected quantity of DCR per event for the entire fleet and all shoreside facilities. These conclusions, summarized below, represent the best available estimates of DCR quantities and are used in this EIS to represent existing conditions (Chapter 3) and predict impacts of the alternatives (Chapter 4).

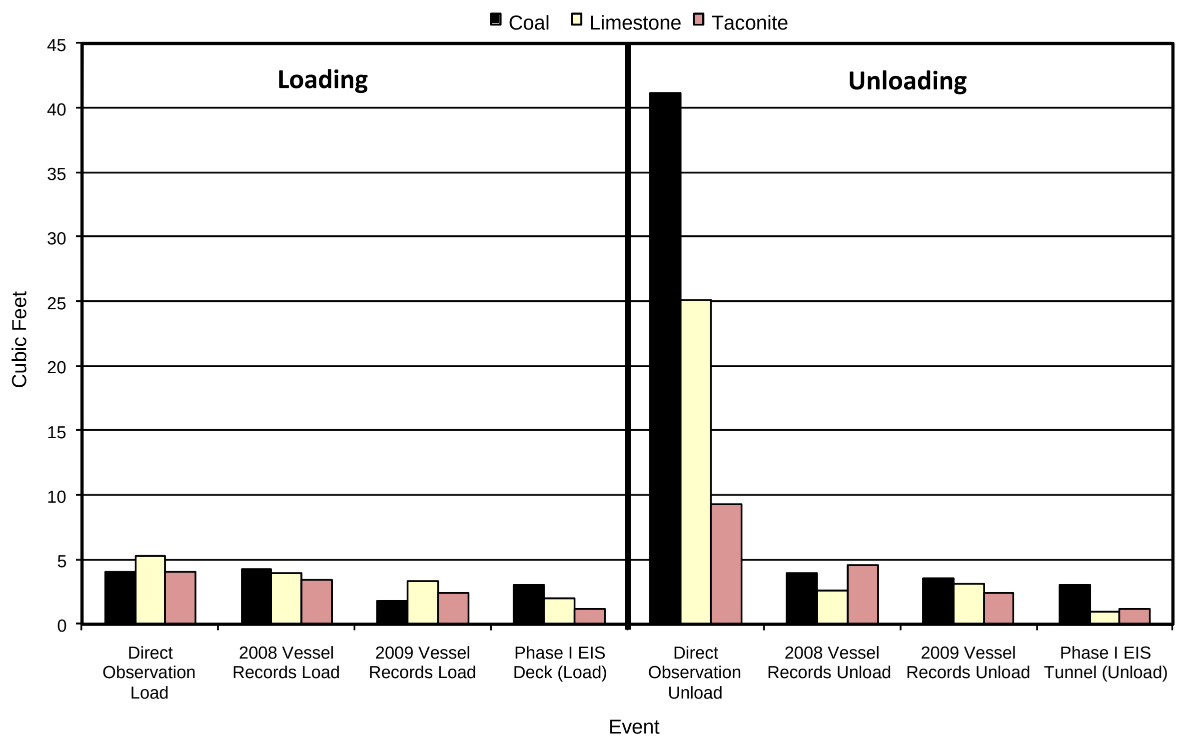
When the median DCR volumes (which is the appropriate statistic for the observed data distribution) from numerous data collection efforts (Direct Observation Program, 2008 vessel records, 2009 vessel records, and Phase I Final EIS) are compared, there is consistency in the loading estimates (Figure 1-7). The median 2004 vessel log DCR discharge volumes are lower than the estimates from other data sets, but only 1 to 3 ft^3 less (about 13 to 72 percent less) for each cargo type. This discrepancy is due likely to the voluntary reporting of 2004 data, where the vessels committed to DCR discharge control may have been more likely to report the volumes, and these same vessels could be expected to produce the least DCR. Of the other data sets, the median loading DCR discharge volume estimates are generally within 1 to 1.5 ft^3 (about 17 to 41 percent) of each other. Given the variability in vessels, operations, and estimating methods, this represents a narrow range and an acceptable quantification of DCR discharge. Thus in this EIS the conservative estimates (i.e., the largest volumes so that impacts will be overpredicted rather than underpredicted) within this range will be used for impact evaluation in this EIS.

The DCR volume estimates for unloading events do not exhibit the consistency observed in the loading estimates (Figure 1-6). The median unloading estimates from all vessel records (i.e., 2004 log entries, 2008 fourth-quarter forms, and 2009 first-quarter forms) are very similar to the corresponding loading events (approximately 3 ft^3 for both loading and unloading, which corresponds to a difference between less than 1 percent and 50 percent).

However, the median DCR-unloading estimates from the observation program are two (taconite) to 10 (coal) times greater than the observation loading events. In fact, the median unloading DCR volume from the vessel records is closer to the observation unloading estimates for the deck alone (about 1 ft^3) than to the total unloading estimate (approximately 10 to 40 ft^3). This indicates that the vessel's DCR discharge estimates for unloading may have ignored or grossly underestimated the DCR in the tunnel. The estimates made as part of the observation program addressed the volume of DCR deposited on the deck and in the tunnel when the vessel left port. The DCR reporting forms were intended to reflect the volume actually discharged; thus any DCR discharge control occurring after the vessel left port would not be included in the observation DCR volume estimates.

Another possible contributing factor is that some crew members do not consider small-grain-size DCR, or "dust," when completing the DCR reporting form, whereas the observation program included all sizes of DCR particles in the estimate. Although there is uncertainty and variability in the observation program estimates for the DCR in the tunnel from unloading events, they were made independently and used actual measurements of DCR volume. Thus, the unloading observation estimates are considered more accurate than the records data and are used in this EIS to represent existing conditions and predict impact.

FIGURE 1-7
Summary of Median DCR Volumes



1.7.3.5 DCR Discharge Control Measures Used and Effectiveness

As detailed in the evaluation of the DCR reporting form and observation program (Appendices C and D) and summarized above, there is a high degree of uncertainty in vessel reporting of discharge control measure use and effectiveness. However, a qualitative review of the DCR reporting form and results of the observation program permit an identification of control measures widely used in the industry. The identified, widely used control measures exist on almost all the vessels and shoreside loading facilities observed (in a limited number of cases a particular control measure was not feasible, or a modified measure served the same purpose), and observations indicated that when all the measures are used in combination, are well maintained, and are operated properly, they can be effective in minimizing DCR.

The effective control measures that were reported by the vessels or observed to reduce DCR discharge are summarized in Table 1-6 for vessels and Table 1-7 for shoreside loading facilities. The vessel control measures generally apply to all cargo types, because the vessels move multiple cargo types. The control measures for shoreside loading facilities are cargo specific, because the facilities typically load only one cargo. Some of the additional control measures reported were specific to individual facilities but were very similar to or simply enhancements to existing control measures.

Quantifying the effectiveness of individual discharge control measures was attempted at the shoreside facility and on the vessel, but it was not always possible because single control measures rarely were used. Multiple control measures were almost always used, and so field observations could not always isolate individual control measures to quantify their effectiveness. Several observations, however, allowed the following control measures to be evaluated for their individual effectiveness:

Scrapers can reduce DCR 67 to 75% for both loading and unloading when they are properly installed and maintained; conveyor belts properly aligned can reduce DCR 50 to 97% over misaligned belts.

- Three DCR volumes were estimated to quantify the effectiveness of belt scrapers. It was shown that scrapers can reduce DCR discharges by three to four times for both loading and unloading when they are properly installed and maintained (a 67 percent to 75 percent reduction of DCR with properly operating belt scrapers).
- Five DCR volumes were estimated to quantify the effectiveness of having a properly aligned conveyor belt. Proper belt alignment was shown to generally reduce DCR discharges by 2 to 30 times (a 50 percent to 97 percent reduction of DCR with a properly aligned conveyor belt). In one case, a significantly misaligned conveyor belt caused over 400 times more DCR than one properly aligned (a nearly 100 percent reduction of DCR with a properly aligned conveyor belt).
- Five DCR volumes were estimated to quantify the effectiveness of conveyor belt skirting. Skirting was shown to reduce DCR discharges by 7 to 30 times (an 85 percent to 97 percent reduction of DCR with conveyor belt skirting).
- A tarp used onshore during one event eliminated DCR at the location where the tarp was placed, but recovering the tarp and DCR was difficult because the tarp was very large and thus difficult for the crew to manage during windy conditions.
- DCR volume from one event was estimated to evaluate a very simple modification to a discharge chute at a coal-loading facility. A rubber flap added to the end of the chute prevented cargo from bouncing over the hatch combing when the cargo holds were topped off. This simple modification reduced DCR discharges 2 to 18 times over a similar coal-loading facility with a similar loading chute but without the rubber flap (a 63 percent to 95 percent reduction of DCR with a rubber flap added to the end of the chute).

These same control measures were qualitatively identified as effective when combined with the DCR reporting form evaluation as discussed above (Section 1.7.3.2).

TABLE 1-6
Effective and Commonly Used Vessel DCR Discharge Control Measures

	Bulk Dry Cargo		
Control Measure	**Coal**	**Taconite**	**Limestone**
Enclosed conveyor (top of conveyor covered)	✓	✓	✓
Troughed conveyor	✓	✓	✓
Skirting	✓	✓	✓
Belt scrapers	✓	✓	✓
Water/mist	✓	✓	✓
Capacity indicators	✓	✓	✓
Communications	✓	✓	✓
Crew training	✓	✓	✓
Broom and shovel	✓	✓	✓
Cargo hold vibrators	✓	—	✓
Careful gate operation	✓	✓	✓

Additional Control Measures Reported by Vessels to Reduce DCR Discharge

1. Provide extra skirting and flanges or ramps at cargo hold gates on the inclined part of tunnel conveyor belt. (This was reported to help funnel cargo to the center of the belt. The flange further helped start the cargo moving in the direction of the belt before the material hit the belt.)
2. Wash tunnel to allow DCR and washwater to be offloaded with the unloaded cargo.
3. Avoid shutting down the conveyor belt when it has material on it.
4. Moor the vessel directly against the shoreside facility, so that the unloading conveyor boom does not have to be fully extended.
5. Lower the height of the unloading conveyor boom, so that the conveyor is as close to the unloading stockpile or hopper as possible.
6. Provide an apron or pan under the portion of the conveyor that overhangs the vessel to prevent scraped material from being deposited on the vessel deck or in the tunnel, and provide water/mist to stop scraped material from sticking to the apron or pan.
7. Replace air gates with hydraulic gate controls.
8. Install automated gates.

✓, effective and commonly used control measure.

1.7.3.6 Summary of DCR Discharge Control Measures

There is a wide variation in the operation, maintenance, and attention to DCR discharge control measures throughout the Great Lakes dry cargo shipping industry. However, there are a limited number of control measures that most if not all vessels and shoreside facilities have or can easily access. When these measures are properly maintained and operated, they can be highly effective in minimizing DCR discharge volumes. Several events that exhibited properly maintained and operated control measures and resulted in reduced DCR volumes were observed. However, not all vessels take advantage of the DCR control opportunities, and loading and unloading events reflecting less attention to the proper operation and maintenance control measures resulted in substantially larger volumes of DCR.

TABLE 1-7
Effective and Commonly Used Shoreside Loading-Facility DCR Discharge Control Measures

	Bulk Dry Cargo		
Control Measure	**Coal**	**Taconite**	**Limestone**
Enclosed conveyor[a]	✓	—	—
Troughed conveyor	✓	✓	✓
Skirting[b]	✓	✓	✓
Belt scrapers	✓	✓	✓
Water/mist	✓	—	✓
Capacity indicators	✓	✓	✓
Stopping conveyor[c]	✓	✓	✓
Communications[c]	✓	✓	✓
Crew training	✓	✓	✓
Loading chute	✓	—	—

Additional Control Measures Reported by Vessels and Shoreside Facilities to Reduce DCR Discharge

1. Provide an apron or pan to prevent the scraped material from being deposited on the vessel deck.
2. Provide a telescoping chute that reaches or extends below the hatch opening to allow cargo to discharge to the cargo hold below the top of the hatch.
3. Do not top off hatches.
4. Install remote controls to allow the shoreside facility loader to be on the vessel and to view the loading process more closely.
5. Close hatches when loading during heavy rain, especially when loading coal.
6. Remove cross bars or other obstructions that the cargo may strike if the loading conveyor is retracted or extended.
7. Do not move the vessel when the loading conveyor is running. Shut down or run the loading conveyor belt clean before the loading conveyor moves between hatches or at the end of the load.
8. Add a rubber flap over the discharge point of the telescoping loading chute.
9. Provide an apron or drip pan under the part of the loading conveyor that overhangs the vessel.

✓, effective and commonly used control measure.
[a]Conveyor enclosed on sides or on sides and on top.
[b]At transfer conveyors.
[c]When vessel or shiploader moves.

CHAPTER 2

Description of Alternatives

2.1 Introduction

Developing, evaluating, and comparing alternatives is key to complying with NEPA. Through this process the advantages, disadvantages, costs, and impacts of each alternative are explored before an alternative is selected and an action is taken. The first step in the process is to identify a reasonable range of alternatives that meet the purpose and need. These alternatives are then evaluated using screening criteria. In this Tiered Draft EIS the process builds on the identification and evaluation of alternatives from the Phase I Final EIS. The process conducted for the Tiered EIS is described below as the identification and screening of alternatives (Sections 2.2 and 2.3). Once the alternatives that meet the purpose and need are identified, they are described in sufficient detail (Section 2.4) so that the impacts can be evaluated for each alternative (Chapter 4). The final step is the comparison of alternatives, which is presented in Chapter 5.

2.2 Identification of Alternatives

2.2.1 Phase I Final EIS Alternatives

The identification of alternatives in this Tiered Draft EIS incorporates the work performed on alternatives in the Phase I Final EIS. Since the purpose and need of the two EISs are consistent, alternatives that did not meet the purpose and need in the Phase I Final EIS are not considered here. The following alternatives from the Phase I Final EIS (Chapter 2 and Appendix D), meet the purpose and need and are therefore considered initially in this Tiered Draft EIS:

- **Alternative 1: No Action.** Allow the IEP to terminate and existing laws and regulations would effectively ban the discharges of DCR into the Great Lakes. As discussed in Chapters 1 and 2 of the Phase I Final EIS various acts and associated regulations would severely curtail if not ban DCR discharges under the No Action alternative. Although this alternative did not meet the purpose and need because it would threaten the continued economic viability of the shipping industry, it was retained because NEPA mandates detailed evaluation for the No Action alternative as a basis of comparison to the action alternatives.
- **Alternative 2: IEP with Recordkeeping (the Phase I Proposed Action).** Adopt the IEP as the basis for Coast Guard regulation with new requirements for standardized recordkeeping.
- **Alternative 3: Proposed Action with Modified Exclusion Areas.** Adopt the IEP with recordkeeping and modify exclusion areas to include additional sensitive areas.

- **Alternative 4: Proposed Action with DCR Control Measures on Vessels.** Adopt the IEP with recordkeeping and require DCR control measures on all vessels carrying bulk dry cargo.
- **Alternative 5: Proposed Action with Shoreside DCR Control Measures.** Adopt the IEP with recordkeeping and require all shoreside facilities loading bulk dry cargo to implement DCR control measures.

In the Phase 1 Final EIS, each of these alternatives was also evaluated with the addition of mitigation limiting DCR discharges in protected and sensitive areas.

2.2.2 Newly Identified Alternatives

During the evaluation of DCR and dry cargo handling for this Tiered Draft EIS, additional alternatives were identified:

- **No Action—Continuation of Interim Rule.** NEPA requires consideration of an alternative representing conditions if the agency took no action to change the current situation. For this Tiered Draft EIS, the No Action alternative would be the continued implementation of the current DCR interim rule which is described in Section 1 and which represents the IEP with Recordkeeping from the Phase I Final EIS.
- **Performance Requirement to Minimize DCR Discharges—Vessel owner/operator required to develop and follow a DCR management plan outlining available, economically practicable, and achievable steps that the vessel takes to control DCR discharges.** Based on public input, review of vessel reporting forms, discussion with regulators, input from shipping industry representatives, and the DCR field observation program as previously described in Section 1.7.3.3, it is apparent that many vessels already minimize DCR discharge volumes. This is accomplished largely through adherence to DCR operational and maintenance procedures consistent with normal vessel and dry-cargo-handling activities. Vessels with the least DCR discharge to the waters of the Great Lakes effectively used best management practices. The specific procedures and equipment vary among vessels and facilities because the conditions, cargoes, and equipment vary.

  Under this alternative, the Coast Guard would establish a “broom-clean” standard for the vessel deck, and would require each vessel owner/operator to develop and implement a management plan that minimizes DCR discharges from the deck and tunnel.

  Although under this alternative shoreside facilities would not be regulated by the Coast Guard- , the vessel owner/operator would also be responsible for coordination with shoreside facilities on measures that the respective shoreside facilities are willing to undertake to help the vessel owner minimize DCR discharges. Selection of specific measures to minimize DCR discharges, whether taken by the vessel, by shoreside facilities, or cooperatively between the vessel and shoreside facilities, would be up to vessel owners/operators to determine and describe in their management plan. Quarterly reporting to the Coast Guard would no longer be required, although vessels would still need to maintain DCR discharge records.

- **Prescriptive Requirement for Baseline Control Measures—Vessel owner/operator required to maintain and operate as intended a defined set of commonly used DCR control measures.** On the basis of the submitted DCR reporting forms and DCR field observations as previously described in Section 1.7.3.3, several operational procedures and types of DCR control equipment were found to be potentially effective in controlling DCR discharges and to be currently in place at all facilities and vessels observed (see Appendix D). This alternative would require these control measures to be used and is similar to Phase I Final EIS Alternatives 4 and 5 summarized above, but more specific. This alternative would require each vessel and shoreside facility to have these baseline control measures installed and to maintain and operate them as designed.

- **Limit DCR Discharges to a Specified Amount.** Instead of requiring severely curtailed discharges of DCR (as in the Phase I Final EIS No Action alternative) or requiring measures to reduce DCR, a maximum allowable quantity of DCR discharges would be specified under this alternative. The quantity could be based on either an acceptable level of environmental protection (and thus would differ by discharge area, DCR characteristics, and associated level of impact) or achievable limits observed in "well-run" vessels.

- **Include DCR as part of the National Pollutant Discharge Elimination System's Vessel General Permit Issued by U.S. Environmental Protection Agency under its Clean Water Act Responsibility.** The U.S. Environmental Protection Agency (EPA) was recently required, as a result of litigation, to issue National Pollutant Discharge Elimination System (NPDES) permits for discharges incidental to the normal operation of vessels. Part of EPA's response to the requirement has been to issue a Vessel General Permit (VGP) (see Appendix H) that covers most discharges for all vessels that are not recreational, not commercial fishing, or not under 79 feet. The VGP does not stipulate a specific discharge limit because EPA has concluded that it is not feasible to calculate numeric water-quality-based effluent limits for vessels at this time. Similarly, EPA finds that it is not feasible to set specific numeric effluent limits for discharges due to variation in vessel size, types of equipment operated on deck, and limitations on space for treatment equipment. In the absence of numerical limits, EPA requires permittees to engage in specific behaviors or best management practices in order to minimize discharges from vessels. In many cases EPA requires the prevention of discharges from several types of shipboard operations to the extent feasible and in other cases requires a vessel's crew to minimize discharges. Inspection, monitoring, recordkeeping, and reporting requirements are also included in the VGP.

  The current EPA VGP excepts Great Lakes DCR discharges from the VGP as long as vessels comply with Coast Guard regulations at 33 CFR 151.66. Under this alternative, the Coast Guard regulation could be amended by removing the Great Lakes provisions of 33 CFR 151.66(b) and (c), and EPA could remove its exception, so that Great Lakes dry cargo carriers would need VGPs covering their dry cargo operations.

2.3 Screening of Alternatives

Alternatives screening is an approach commonly used as part of the NEPA environmental evaluation process to identify feasible alternatives and to ensure that a reasonable range of alternatives is considered for detailed evaluation. It also is used to ensure that unreasonable alternatives are identified at an early phase of the evaluation, so that the process can be focused on other, more critical issues and alternatives.

Screening criteria supporting the purpose and need were developed as part of the Phase I Final EIS (Table 2-1), and all identified alternatives were compared to the criteria (Phase I Final EIS, Section 2 and Appendix D). The screening criteria developed for the Phase I Final EIS were reviewed and found to also be appropriate for this Tiered Draft EIS evaluation because the purpose and need are consistent for the two EISs. Therefore, in the following subsections, the alternatives identified in Section 2.2 were evaluated in light of the criteria developed for the Phase I Final EIS. This process identified those which met all the screening criteria, and thus the purpose and need, and will be carried further in this EIS for detailed evaluation.

TABLE 2-1
Alternatives' Screening Criteria

	Description
1	Prevent impacts that significantly degrade Great Lakes aquatic resources.
2	Regulate with only minimal additions to existing Coast Guard organizational structure and resources.
3	Avoid regulating bulk dry carriers and related shoreside facilities in a way that threatens their continued economic viability.
4	Avoid regulating bulk dry carriers in a way that threatens their safe operation.
5	Minimize additional energy use.
6	Provide an adequate and appropriate recordkeeping and compliance monitoring system.
7	Use proven DCR control measures.

2.3.1 Screening of Phase I Final EIS Alternatives

The Phase I Final EIS No Action alternative (Alternative 1) was found to threaten the continued economic viability of the shipping industry (Screening Criterion 3). Since it does not meet all the criteria and is no longer the No Action alternative for this Tiered Draft EIS, it does not warrant further consideration and will not be evaluated here.

For this Tiered Draft EIS, the Interim Rule, i.e., the IEP with Recordkeeping alternative (Phase I Alternative 2) now becomes the No Action alternative and under NEPA regulations must be evaluated in detail. It meets all of the screening criteria. As currently implemented the IEP with Recordkeeping includes reporting and modified exclusion areas. It is retained and will be carried forward here.

Modifying the exclusion areas (Alternative 3, Proposed Action with Modified Exclusion Areas) meets the screening criteria. However, exclusion area modifications can be combined with any of the other alternatives as a mitigation measure in areas where impacts are identified, as it was previously in the Interim Rule (now No Action alternative). Therefore, it does not contribute to the NEPA analysis as a distinctly different alternative and will be considered here as a possible addition to other alternatives rather than as a stand-alone alternative.

The two alternatives from the Phase I Final EIS that require DCR control measures (Alternative 4, Proposed Action with DCR Control Measures on Vessels, and Alternative 5, Proposed Action with Shoreside DCR Control Measures) were also found to be consistent with all screening criteria. However, based on a more thorough understanding of bulk dry cargo handling and DCR operations gained through the DCR reporting forms and observation program, a more detailed and comprehensive alternative—a prescriptive requirement for baseline control measures—that accomplishes the same purpose can now be identified. Detailed evaluations of Alternative 4 (Proposed Action with DCR Control Measures on Vessels) and Alternative 5 (Proposed Action with Shoreside DCR Control Measures) would duplicate the detailed evaluation of the Baseline Control Measures alternative. Thus Alternatives 4 and 5 from the Phase I Final EIS are not actually eliminated but rather addressed through a detailed evaluation of the new baseline control measures alternative. It is therefore redundant to carry forward the less-specific control measures alternatives from the Phase I Final EIS, and they will not be evaluated further here.

2.3.2 Screening of Newly Identified Alternatives

- **The No Action alternative**—now IEP with recordkeeping, reporting, and modified exclusion areas—is required by NEPA and therefore will be evaluated in detail in this EIS.
- **The Performance Requirement to Minimize DCR Discharges and the Prescriptive Requirement for Baseline Control Measures alternatives** meet all the screening criteria and will therefore be carried forward for detailed analysis in this Tiered Draft EIS.
- **To Include DCR as Part of VGP alternative** would impose requirements embodied in other DCR alternatives. As discussed above, in order to control pollutant discharges, EPA's VGP requires vessels to support specific equipment and procedures where feasible and to minimize discharges where specific procedures or equipment is not required. However, because DCR was not subject to the exclusion from NPDES permitting, it is not eligible for coverage under the VGP. Therefore, permitting of DCR falls under Great Lakes states with NPDES delegation. For this reason to Include DCR as Part of VGP alternative will not be evaluated further.
- **The Limit DCR Discharges to a Specified Amount alternative** presents significant operational and administrative challenges. Determining specific environmental protection discharge limits for each area and cargo would be very time consuming and costly. Similarly, as discussed in Section 1.7, the DCR quantities from even the "best-run" vessels vary greatly based on cargo type and whether the event is a loading or an unloading. Developing and enforcing maximum allowable DCR discharges for a wide variety of cargos, differing lake conditions, and transfer events could not be accomplished within the existing Coast Guard organizational structure and resources.

  Also, imposition of a specific discharge limit is generally accompanied by a requirement for discharge monitoring reports (e.g., NPDES permits under the Clean Water Act, or CWA) to enforce quantity-based discharge permits. The collection and review of such reports could not be accomplished within the existing Coast Guard structure and resources.

  This alternative is not consistent with the shipping industry's current practices and level of effort and expertise, and would likely result in substantial compliance and monitoring problems. Bringing vessels into compliance with such a new and different program would also require substantial Coast Guard effort outside of the existing Coast Guard organizational structure and resources.

Because the Limit DCR Discharges to a Specified Amount alternative does not meet the screening criteria of implementation and enforcement within existing structure and resources and use of proven control measures, it was eliminated during screening and is not carried forward for detailed analysis. The EPA went through an extensive effort to evaluate applying quantitative limits and reached the same conclusion: that it is would be neither practicable nor feasible to limit discharges from vessels to a specified amount. (See Section 2.2. and http://cfpub.epa.gov/npdes/home.cfm?program_id=350.)

2.4 Alternatives for Detailed Analysis

Based on the alternatives screening above, the following newly numbered and named alternatives will be considered in detail in this Tiered Draft EIS:

- Alternative 1: No Action (Interim Rule)
- Alternative 2: Performance Requirement to Minimize DCR Discharges
- Alternative 3: Prescriptive Requirement for Baseline Control Measures

Each of these alternatives is detailed below. The capital and operating costs for the alternatives were estimated using assumptions of how the shipping industry might comply with the alternatives (Appendix E). For example, the Performance Requirement to Minimize DCR Discharges alternative specifies the result, minimizing DCR discharges, but does not mandate a particular approach. The method of minimizing DCR discharges is solely up to the owner/operator of the vessel and may include measures affecting the vessel exclusively, measures affecting shoreside facilities exclusively, or measures taken cooperatively by the vessel and shoreside facilities.

For the Tiered Draft EIS, 10 DCR control alternatives were identified; 3 fully met the purpose and needs and were carried forward for detailed evaluation.

Thus the methods used in this alternatives analysis are assumptions to assist in estimating a reasonable cost range for achieving the performance requirement of the rulemaking. However, these assumptions do not stipulate any particular action as a specific mandated method required by the alternative. The owner/operator could choose one of the methods assumed for costing or some other approach suited to the specific equipment and operating procedure of the specific vessel or shoreside facility.

2.4.1 Alternative 1: No Action

The No Action alternative would be the continuation of the current DCR interim rule's approach, which is described in Chapter 1. The interim rule would become a final rule without substantive changes. This No Action alternative forms the basis for comparing predicted conditions for each action alternative in the NEPA process; that is, a predicted impact from an alternative represents a change from the conditions that would exist if the Coast Guard took no action regarding DCR rulemaking.

This alternative represents the Phase I Proposed Action (Interim Rule) described in the Phase I Final EIS, identified as the preferred alternative, and selected for implementation in the Record of Decision (ROD). It also substantively represents the DCR management practice that has occurred for much of the last century. Although bulk dry-cargo-handling procedures have changed over the decades with the effect of limiting DCR discharges, more dry cargo has been shipped in the second half of the century. Thus the historic annual average DCR discharges are similar to that expected under this alternative, and the impacts produced by past practices are similar to those anticipated for this alternative.

This alternative includes mandatory restrictions on DCR discharges in nearshore waters and other environmentally sensitive areas (Appendix F describes the specific restrictions and areas). Discharges of DCR in nearshore exclusion areas are prohibited because they were determined through an evaluation process with the National Oceanic and Atmospheric Administration (NOAA) and other stakeholders to be environmentally sensitive (Reid and Meadows, 1999). As a result of the Phase I Final EIS, additional exclusion areas were added to protect designated resource areas such as national parks, national lake shores, national wildlife refuges, national marine sanctuaries, and a national estuarine research reserve.

These exclusion areas are part of the No Action alternative in this Tiered Draft EIS. As with the current interim rule, the No Action alternative allows DCR discharges of limestone and clean stone to continue in port and nearshore areas not otherwise identified as environmentally sensitive.

Other elements of the No Action alternative address recordkeeping, reporting, and DCR control measures. Under this alternative and consistent with the interim rule, all U.S. vessels and each vessel loading, unloading, or discharging bulk dry cargo in U.S. waters of the Great Lakes must complete a Coast Guard DCR reporting form (see Section 1.7.3), and these forms must be submitted quarterly to the Coast Guard. Under the interim rule, and thus this alternative, all vessel owners and operators are also encouraged, but not required, to reduce DCR discharges by implementing voluntary DCR control measures.

There are no incremental costs associated with this alternative because all of the DCR control and management equipment, procedures, and effort associated with this alternative already exist. Thus no expenditure beyond those in place would be required. The cost estimates for the other alternatives represent the costs above and beyond the costs associated with DCR control and management under the No Action alternative.

TABLE 2-2
Predicted DCR Discharge Volume per Discharge Event for Alternative 1: No Action

	Median	Mean
Loading		
Coal (ft^3)	3.4	11.6
Limestone (ft^3)	3.7	18.8
Taconite (ft^3)	3.0	19.3
Unloading		
Coal (ft^3)	41.1	48.9
Limestone (ft^3)	25.1	241.2
Taconite (ft^3)	9.3	9.3

Since the No Action alternative represents current practices, the volume of DCR discharge from this alternative would be equivalent to what currently occurs. The volumes of discharge for each cargo type for loading and unloading are summarized below in Table 2-2 and described in detail in Appendix D. The estimated DCR discharge volumes for this alternative will be used in comparison to predicted DCR discharge volumes for other alternatives to predict impacts (Chapter 4) and compare alternatives (Chapter 5).

2.4.2 Alternative 2: Performance Requirement to Minimize DCR Discharges

This alternative would require vessel owners/operators to minimize the discharges of DCR to the waters of the Great Lakes using methods they select and document in DCR management plans. It reflects the USCG observations of DCR loading and unloading activities, which revealed that significant reduction in DCR discharge can be achieved by careful attention to operations and implementation of readily available control measures that require minimal or no additional effort.

Alternative 2 requires vessels to select approaches to minimize DCR discharges that best fit their specific equipment and operations. These approaches must be documented in a DCR management plan.

This alternative recognizes the unique issues of controlling DCR discharges from vessels created by the variation among cargo type, vessel equipment, vessel operation, and shoreside facilities, among other factors. It accommodates variations in equipment and operating procedures among vessels and shoreside facilities. This alternative charges the owners/operators, who best know their specific conditions and how they interact with shoreside facilities, to formulate the measure or measures most appropriate to their situation to minimize DCR discharges. This alternative, which is similar to the VGP, defines “minimize” as reducing or eliminating discharges to the extent achievable using control measures (including best management practices) that are available, economically practicable, and achievable in light of best marine practice.

This alternative addresses a performance result (minimizing DCR discharges) but does not prescribe to the vessel owner/operator or shoreside facility how to achieve the result. A net reduction in DCR discharges is expected to occur as a result of:

- Mandatory DCR Management Plan, with a focus on minimizing DCR discharges through methods of the vessel owner or operator's choice
- Broom-clean standard applying to the deck after each loading and unloading operation, using methods and approaches determined by the vessel owner or operator
- Management of tunnel DCR to minimize discharges using methods and approaches determined by the vessel owner or operator and reflected in the Management Plan

DCR deposits on deck generally fall into two categories: concentrated areas and more scattered or dispersed deposits. Management of the more concentrated areas with a goal of minimizing DCR discharges would be addressed in the DCR Management Plan. A broom-clean deck standard would address the second category and would prevent discharges of all dispersed deck bulk dry cargo residues except that consisting of dust, powder, or isolated and random pieces, none of which exceeds 1 inch in diameter. Figure 2-1 shows examples of areas that would be considered a violation as a result of either not meeting the broom-clean deck standard or not managing concentrated areas consistent with DCR Management Plan requirements.

FIGURE 2-1
Areas Not Meeting Either DCR Management Plan or Broom-Clean Standard Requirement on Vessel Decks

Note: Photographs are not comprehensive in showing all types of areas that would be addressed by either the DCR Management Plan or broom clean standard, but show representative examples of areas.

As seen during operation observations as part of this Tiered Draft EIS, much of the DCR in the tunnel accumulates in areas that are difficult to access, often limiting DCR collection with a broom and shovel to the walkways. Also, the tunnels can be wet and in some cases have standing water which is not conducive to broom sweeping or shoveling. Thus a "broom clean" standard is generally not achievable for a vessel's tunnel.

Options for reducing DCR discharges include various measures to sweep, collect, and combine concentrated areas of DCR from decks with loaded or unloaded cargoes to meet the broom clean standard (e.g., Figure 2-1). Similarly, discharges of DCR from the tunnel

(Figure 2-2) may be controlled by collecting and combining the DCR with loaded or unloaded cargo. Collected DCR may also be disposed of directly at a shoreside facility. Regardless, DCR discharges can usually be controlled by preventing concentrated areas of DCR from accumulating on deck or in tunnels.

FIGURE 2-2
Examples of Obvious DCR Build-Up in Vessel Tunnels to be Addressed by DCR Management Plans

None of the measures discussed below, or any other specific measures, would be requirements for vessels or shoreside facilities under this alternative. Rather, they are options observed during preparation of this Tiered Draft EIS and used to estimate costs of the alternative and impacts associated with DCR discharges. The requirement is to minimize DCR discharges. Minimization of DCR discharges was noted during the observation program as careful adherence by vessels to the example methods listed below and similar measures. The formulation of this alternative draws from the observations, discussions with shipping personnel, and engineering experience.

This alternative also includes DCR discharge exclusion areas and recordkeeping requirements modified from the interim rule. It includes the same mandatory restrictions on DCR discharges in nearshore waters and other environmentally sensitive areas (Appendix F) as the current interim rule (which is the same as those described above for the No Action Alternative).

The recordkeeping requirements for this alternative are more flexible than the interim rule. Records would not need to be kept on a specific form and would not need to be reported to the Coast Guard. Instead, each vessel owner or operator would have to keep on board a record of the following DCR discharge-related information for at least two years:

- Where and when DCR discharges take place
- The type of DCR discharged
- The estimated volume of each discharge

2.4.2.1 DCR Management Plan

Each vessel owner or operator will develop a DCR Management Plan with vessel-specific elements describing DCR control equipment, provisions, and operating procedures best suited to their vessel to minimize DCR discharges to the Great Lakes. Maintaining a plan would also require the owner/operator to evaluate their vessel and procedures periodically to identify DCR control opportunities, to review the plan as new technologies or procedures are developed, and to update the plan as needed to make sure that the vessel can still minimize discharges in comparison with other comparable vessels that have adopted newer technologies or procedures. The plan also will summarize coordination with shoreside facilities if the vessel includes the shoreside facilities as part of their approach for minimizing DCR discharges. In addition, the management plan requirement facilitates the Coast Guard's implementation and enforcement because the DCR Management Plan must be on board the vessel in paper form and available to the Coast Guard during inspections.

The DCR Management Plan substantially limits, and possibly prevents the future increase of DCR discharges from each vessel. Under Alternative 1: No Action, there is nothing to prevent vessel owner/operators from abandoning existing DCR control procedures and equipment in the future, which could result in increased environmental impacts. However, the DCR Management Plan and enforcement by the Coast Guard will result in maintenance, periodic review and possible updating, and adherence to DCR control measures designed to minimize discharges to the Great Lakes.

The DCR Management Plan for each vessel must describe the specific measures the vessel employs to ensure the minimization of DCR discharges and at a minimum must list or describe:

- Equipment onboard the vessel that is designed to minimize bulk dry cargo spillage during loading and unloading

- Equipment onboard the vessel that is available to recover spilled cargo from the decks and transfer tunnels and return it to the holds or to unloading conveyances

- Operational procedures employed by the vessel's crew during the loading or unloading of bulk dry cargoes to minimize cargo spillage onto the decks and into the transfer tunnels and to achieve and maintain the broom clean deck condition required by paragraph (b)(4) of this section

- Operational procedures employed by the vessel's crew during or after loading or unloading operations to return spilled bulk dry cargo residue to the vessel's holds or to shore via an unloading conveyance

- How the vessel's owner or operator ensures that the vessel's crew is familiar with any operational procedures described by the plan

- The position title of the person onboard who is in charge of ensuring compliance with procedures described in the plan

- Any arrangements between the vessel and specific ports or terminals for the unloading and disposal of the vessel's bulk dry cargo residues ashore

- The procedures used and the vessel's operating conditions to be maintained during any unavoidable discharge of bulk dry cargo residue into the Great Lakes

2.4.2.2 Options to Minimize DCR Discharges Resulting from Loading Activities

To estimate costs for the alternative, two possible scenarios were developed to minimize DCR discharges associated with loading activities. As discussed above, these scenarios are only to estimate a cost range and in no way mandate a requirement under this alternative. Vessel owners/operators have the option of developing a working plan that best fits their specific equipment and procedures.

For loading operations, this alternative would place discharge minimization requirements on the vessel and require that a broom-clean standard be maintained on the deck. The greatest opportunity for DCR generation during loading rests with the equipment and operations at the shoreside facility, and it would be up to the vessel owner/operator to coordinate with the shoreside facility to take appropriate, economically practicable, and achievable steps to reduce DCR. This could include minimizing residue falling on the vessel deck through proper maintenance and operation of equipment effective in controlling DCR (e.g., proper adjustment of cargo conveyer belt scrapers).

As an example, one option to minimize DCR discharges associated with the deck and maintain a broom-clean standard is to collect DCR on the deck after loading an individual cargo hold and adding the collected DCR back to the cargo. It could also include careful operation of the loading equipment such as ensuring the loading equipment is properly positioned over the vessel cargo hold before the loading conveyor belt is started, lowering the end of the loading chutes below the cargo hold hatch opening, regulating loading rate to not overwhelm the loading mechanisms, running the conveyor belts empty over the vessel cargo hold after the feed is halted, and stopping the conveyor belts prior to filling subsequent cargo holds.

It may also be possible on some vessels to position tarp(s) under the loading conveyor to ease DCR collection after loading. The vessel operators also may limit DCR by working closely with the shoreside facility through better communication, to encourage proper operation and coordination of the loading operation. The vessel owner/operator will select and document in the DCR Management Plan the combination of methods most appropriate to an individual vessel.

2.4.2.3 Options to Minimize DCR Discharges Resulting from Unloading Activities

Minimization of DCR discharges associated with unloading operations is primarily the responsibility of the vessel owners/operators. The shoreside facility has little or no control over the cargo while it is on or over the vessel. As is true for loading operations, this alternative does not require specific control measures or operating procedures but does mandate that owners/operators take actions to minimize DCR discharges.

Generally more than 90 percent of DCR was observed to be generated in the vessel tunnel. Consequently, measures on deck can achieve only limited reduction in discharges of DCR generated during unloading. Although unloading generates little deck DCR, it could be minimized by vessel personnel in a similar manner to that described above for loading operations.

The greatest opportunity to minimize DCR discharges exists in the tunnel since the greatest source of DCR is from cargo hold spillage into vessel tunnels, which predominantly occurs during cargo unloading. There are numerous methods that could be used to minimize discharges associated with tunnel DCR. One method to minimize tunnel DCR discharges is to minimize the amount of concentrated tunnel DCR during the unloading activity. This might be done by collecting the concentrated piles of DCR generated during unloading, (e.g. belt scrapers, pinch points) and placing the DCR back onto the conveyor belt during the unloading activity if it does not create a safety hazard.

Careful operation of cargo hold unloading gates and attention to the capacity of the conveyor belt and use of hold vibrators to produce a smooth and steady flow of cargo to the unloading conveyor belt can limit cargo falling off the belt and resulting in DCR. Also, maintenance activities such as ensuring the unloading conveyor belt is centered under the gates and properly adjusting belt scrapers can minimize the deposition of DCR and ultimately its discharge.

Another method to minimize tunnel DCR discharges is to modify the existing sump pump piping to discharge tunnel washwater onto the moving conveyor belt during the unloading activity. This modification is only effective during the unloading operation when there is already cargo on the unloading conveyor belt, which could form a slurry with the addition of the usually wet tunnel DCR. However, at the end of unloading, when the conveyor belt does not have cargo on it, the washwater and associated DCR cannot be effectively transported and unloaded to the cargo-receiving port because the conveyor belts are not intended to transfer liquids. Where there is suspended DCR in large amounts of tunnel water, an additional crewperson may be required to sweep the tunnel during offloading activities.

Use of a screen or grate over the tunnel sump is another option that might be considered to reduce the larger DCR particles that enter the sump, and this could further minimize the tunnel DCR discharged to waters of the Great Lakes. The material collected on the screens could be placed on the conveyor belt or held in containers for transfer to shore when the vessel is in port.

2.4.2.4 Estimated Cost for the Minimize DCR Discharges Alternative

As discussed above, under this alternative the specific equipment and procedures to achieve reductions in DCR discharges are the choice of the vessel owners/operators, by themselves or in cooperation with facility owners and operators. This is because the most effective and efficient approaches are dependent on the specific conditions of the vessel or shoreside facility, which are best understood by the vessel's owners/operators. Based on the variability among vessels and shoreside facilities, there would be a similar variability among DCR discharge minimization approaches and it is not feasible in this EIS to estimate the costs of every possible discharge minimization approach.

For the purpose of this Tiered Draft EIS a range of costs was estimated for Alternative 2. The lower end of the range represents maintaining a broom clean standard on deck, developing a management plan, and a credit for eliminating the DCR management reporting requirement for each vessel. The upper end of the range was estimated as these activities plus assumed procedures (based on best engineering judgment and observations of DCR loading and unloading activities) in the tunnel to minimize DCR discharge. Costs may vary with specifics of the approach, ranging from more efficient use of existing personnel to greater care in operations, to modifications to convey DCR back to the cargo hold or onto a a shore facility. Summary costs are provided in Section 4 as part of the impact assessment. A detailed methodology, assumptions, and costs are presented in Appendix E of this Tiered Draft EIS.

2.4.2.5 Estimated Minimize DCR Discharges Volume

The DCR discharge volumes predicted for this alternative are summarized in Table 2-3and detailed in Appendix G. Both observations of DCR management practices and review of vessel record forms were reviewed to formulate the predicted DCR discharge volumes for loading and unloading events. However, estimates for unloading events are based primarily on the observations because, as described in Appendix D, the vessel records are highly variable and unreliable for unloading events. The predictions for DCR discharges associated with unloading events are based on observed events that most closely represented the conditions consistent with the description of the alternative. Although the observations were also used for the predictions of DCR resulting from loading events, the DCR discharge predictions associated with loading events were based primarily on the vessel records. The vessel records were the primary source because they constitute a much larger sample and, for loading events, they were generally validated by the observations.

TABLE 2-3
Predicted DCR Discharge Volume per Discharge Event for Alternative 2: Performance Requirement to Minimize DCR

	Median	Mean	
Loading			
Coal (ft^3)		3.4	3.6
Limestone (ft^3)		3.7	4.9
Taconite (ft^3)		3.0	4.5
Unloading			
Coal (ft^3)		6.3	6.3
Limestone (ft^3)	4.7	4.7	
Taconite (ft^3)	4.3	3.9	

The predicted DCR volumes and associated discharges for both unloading and loading events include a safety factor to conservatively estimate DCR volumes and the impacts resulting from the DCR discharges, thus avoiding under prediction of impacts. Where actual conditions reflective of this alternative were not observed for any unloading event, engineering judgment was required to estimate the volume of DCR that would result and be discharged if all of the conditions specified in the alternative were achieved. Consistent with the conservative approach of estimating discharge volumes, in these cases the predictions are based on engineering judgment and reflect only half the DCR discharge reduction estimated relative to the No Action alternative. Similarly, for loading events, the predicted DCR discharge volumes reflect control of only those loading events resulting in the largest volumes of DCR discharges and no reductions of the lower volume discharge events were included in the estimate.

These conservative factors were applied to the predictions to account for uncertainty, effects of weather or other complicating factors, accidents, equipment failures and lack of full and consistent compliance with the requirement of the alternative. Full and consistent adherence to this alternative would result in substantially lower volumes of DCR discharge than those predicted for the impact evaluation.

Analysis of DCR discharge records from 2000, 2004, 2008, and 2009 and observation of cargo operations (Section 1.7.3) were used to estimate the discharge volume for this alternative. Using this information, separate estimates were made for loading and unloading of each major cargo type (coal, limestone, and taconite). The estimates were made by identifying the observed DCR discharge volume representing a vessel or shoreside facility most closely reflecting the minimization approaches consistent with this alternative (e.g., collecting concentrated areas of DCR and careful gate operation). These estimates were then compared to the frequency distribution of DCR volume reported in the various records and adjusted using engineering judgment to reflect a volume that was reported by a majority of vessels. Derivation of DCR discharge volumes estimated to represent this alternative is described in detail in Appendix G, and the values are summarized in Table 2-3. As with the cost estimates, the estimated DCR volumes presented in Table 2-3 are estimates used to predict impacts (Chapter 4) and compare alternatives (Chapter 5). They are not requirements for a rule based on this alternative.

2.4.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures

This alternative would require all vessels and shoreside loading facilities to maintain and operate as designed a set of control measures that were observed as effective at controlling DCR if implemented, operated, and maintained properly (as described in detail in Appendix D). These measures or an equivalent measure suitable to the conditions of a specific situation were present on all facilities and vessels visited as part of the observation program (13 shoreside loading facilities and 12 vessels were observed). For this Tiered Draft EIS, the findings from the representative observations were extrapolated to represent the Great Lakes bulk dry cargo shipping industry. Thus, to structure and estimate costs for this alternative, the baseline control measures, or their equivalents, are considered to be universally present on vessels and shoreside loading facilities throughout the shipping industry. Accordingly, since these measures, or their equivalent are currently in place, there are no capital costs to install the measures associated with this alternative. Similarly, since they are currently present their replacement costs are considered part of normal vessel and shoreside facility operation costs, and not an additional cost incurred by adherence to the requirement of the alternative.

Alternative 3 requires vessels and shoreside facilities to maintain and operate as designed various DCR control measures that are currently and commonly in place throughout the industry.

In contrast to Minimize DCR Discharges (Alternative 2), the Baseline Control Measures alternative *would* require specific equipment and procedures and require that all vessels and shoreside loading facilities have the measures, or their equivalent, and maintain them such that they operate as designed to control DCR. Observations indicated that effective maintenance and operation of the measures could substantially reduce DCR. But unlike the Minimize DCR Discharges alternative, this alternative would require these measures, and not the specific reduction in DCR discharges.

The baseline control measures were documented for all vessels and shoreside facilities in the observation program as summarized in Table 2-4.

TABLE 2-4
Baseline Control Measures

Control Measure	Coal	Taconite	Limestone
Shoreside Loading Facility			
Troughed conveyor	✓	✓	✓
Skirting	✓	✓	✓
Belt scrapers	✓	✓	✓
Water/mist	✓	—	✓
Stop conveyor	✓	✓	✓
Communications	✓	✓	✓
Crew training	✓	✓	✓
Loading chute	✓	—	—
Vessel			
Troughed conveyor	✓	✓	✓
Skirting	✓	✓	✓
Belt scrapers	✓	✓	✓
Water/mist	✓	✓	✓
Capacity indicators	✓	✓	✓
Communications	✓	✓	✓
Crew training	✓	✓	✓
Broom and shovel	✓	✓	✓
Cargo hold vibrators	✓	—	✓
Careful gate operation	✓	✓	✓

✓, baseline control measure

—, not a baseline control measure.

However, given the variety and diversity of cargo handling equipment and methods, all vessels and shoreside facilities throughout the entire industry may not have these specific measures. Instead they may either have measures that are equivalent in controlling DCR or have demonstrated that in a specific situation the measure would not contribute to DCR control. Thus under this alternative, every vessel and shoreside loading facility would be required to have the required measures for their operation (Table 2-4), demonstrate they have control measures that achieve the same level of control, or demonstrate that the situation does not warrant the specified control measure. In either case (baseline control measures or equivalent), the measures would need to be maintained so that they operate as designed and intended.

The DCR discharge exclusion areas and recordkeeping requirements for the Baseline Control Measures alternative are the same as those described above for Alternative 2 (Performance Requirement to Minimize DCR Discharges).

For the purpose of this Tiered DEIS a range of costs was estimated for Alternative 3. Since, by definition, the baseline measures are already in place, there would be no capital costs. Similarly, this alternative would not create new replacement costs because costs of replacing equipment that is already present would be part of normal operating and maintenance costs. There would, however be increases in operation, maintenance, and training costs to ensure the baseline control measures function as intended. Summary costs are provided in Section 4 as part of the impact assessment. A detailed methodology, assumptions, and costs are presented in Appendix E of this Tiered Draft EIS.

The DCR discharge volumes for Alternative 3 were estimated using the approach described above for the minimize DCR alternative and described in detail in Appendix G; values are summarized in Table 2-5.

TABLE 2-5
Predicted DCR Discharge Volume per Discharge Event for Alternative 3: Prescriptive Requirement for Baseline Control Measures

	Median	**Mean**
Loading		
Coal (ft^3)	3.7	5.1
Limestone (ft^3)	3.7	7.1
Taconite (ft^3)	3.0	8.3
Unloading		
Coal (ft^3)	34.0	32.0
Limestone (ft^3)	15.0	15.0
Taconite (ft^3)	4.7	4.7

2.5 Comparison of Alternatives

The impacts of each alternative are described in Chapter 4 and compared in Chapter 5.

CHAPTER 3

Affected Environment

3.1 Introduction

Chapter 3 describes the environmental and socioeconomic conditions and resources most likely to be affected by the Proposed Action and other alternatives. The identified areas of potential effect described below are refined from the Phase I Final EIS to serve as a baseline from which to identify and evaluate potential impacts. In compliance with NEPA, Council on Environmental Quality (CEQ) regulations (40 CFR 1501.7 (a) 2 and (a) 3, Coast Guard Implementing Regulations for NEPA (COMDTINST M16475.1D), and Department of Homeland Security Management Directive 023-01, the description of the affected environment focuses on those conditions and resource areas that are potentially subject to the effects from the Proposed Action or alternatives.

Resource areas described in this Tiered Final EIS are limited to those with potential resource impacts, as determined in the Phase I Final EIS and in evaluations conducted for this EIS.

The following resource areas were determined to be outside the area of potential effect for all alternatives in the Phase I Final EIS, and no aspects of the alternatives in this Tiered Final EIS would change this conclusion. In addition, neither the previous analyses nor public comments have identified additional areas of impact, and thus these resources were eliminated from further description and study in the Tiered Final EIS:

- Geologic resources
- Topography and soils
- Hydrology and floodplains
- Air quality
- Noise
- Potential hazardous materials
- Land use and housing
- Cultural resources
- Visual and aesthetic resources
- Land-based traffic
- Water-dependent recreation
- Population and services

In the Phase I Final EIS, the description of the affected natural environment (sediments, water quality, and biological resources) was sufficient to adequately predict impacts and develop mitigating measures. Consequently, for these resource categories, the Tiered Final EIS focuses on previous assessments and summarizes those in Section 3.2 rather than repeating information previously provided in the Phase I Final EIS.

Data gathering conducted as part of the Phase I Final EIS revealed that socioeconomic data on the prevalence, cost, and effectiveness of various DCR control measures were inadequate. Thus, additional data were gathered in these areas from port and vessel surveys, vessel-prepared monitoring reports, and onsite observation. Data also were gathered on other aspects of socioeconomic resources to support the impact evaluation in this Tiered Final EIS.

3.2 Summary of Existing Conditions

The Great Lakes are a significant national and Canadian resource, comprising 95,170 square miles of water surface—about 61,000 in the U.S. and 34,000 in Canada—with 10,000 miles of coastline—about 5,200 miles in the U.S. and 5,100 miles in Canada (Michigan DEQ, 2009). The land area abutting the lakes accounted for about 9 percent of the U.S. population in 2000. Twenty-five U.S. cities with populations greater than 100,000 lie within 100 miles of a Great Lakes port, and the Great Lakes represent 90 percent of the total U.S. volume of freshwater lakes. They are the largest source of fresh water in the world, and provide water for more than 40 million people, with about 56 billion gallons per day used by municipalities, agricultural producers, and industries. In addition, the Great Lakes system is a major source of revenue and employment for the region, with primary economic activities ranging from raw materials extraction to industrial manufacturing, steel production, shipping, commercial and sport fisheries, and recreation and tourism. As discussed in the Phase I Final EIS, a critical amount of revenue is dependent on the commodities associated with bulk dry cargo and vessel activity in the Great Lakes–St. Lawrence Seaway System.

An overview of the physical, hydrologic, and watershed characteristics of each lake is provided in Section 3.3.1 of the Phase I Final EIS.

3.2.1 Sediment Quality

The term "sediment" in the context of this discussion refers to the unconsolidated materials that settle at the bottom of the Great Lakes: particles of sand, clay, silt, and other substances derived from eroding soil, decomposing plants and animals, and other material. Sediments play a critical role in the recycling of nutrients in aquatic ecosystems and provide habitat for benthic, or bottom-dwelling, organisms. In the area of concern for this EIS, primarily the open waters of the Great Lakes that lie within and near established shipping lanes, the sediments generally consist of fine-grained particles that form a mud substrate.

Sediment quality is a measure of the ability of sediment to support a healthy population of benthic organisms. As such, sediments provide an important source of food and habitat for benthic organisms. The quality of the sediment can be influenced by the deposition, dissolution, and incorporation of DCR and particles from other sources.

The following sections summarize information provided in the Phase I Final EIS on sediment chemistry, sediment physical structure, and the natural sediment and DCR deposition rates in the Great Lakes.

3.2.1.1 Sediment Chemistry

Toxic and persistent chemicals have accumulated in Great Lakes sediments because of discharges from maritime activities, industrial facilities and sewer overflows, and from urban and agricultural runoff. The highest levels of sediment contamination generally are found in urban harbors, embayments, and river mouths along the Great Lakes. EPA (2007) reported that sediment is the largest source of contaminants in harbors of the Great Lakes. Concern regarding sediment quality in the past has focused on shoreline areas because contaminant generation is most frequently associated with land-based or nearshore activities.

To evaluate sediment quality in specific areas of potential future DCR discharges, sediment samples were collected in May 2007 from bulk dry cargo track lines with areas of historically high DCR discharge rates (two in Lake Superior, one in Lake Michigan, and two in Lake Erie), as detailed in the Phase I Final EIS. The results indicate sediment concentrations are very similar within and outside of track lines and similar to values reported in the literature.

Sediment samples also were collected from shipping lanes for toxicity testing to determine whether the sediments were toxic to benthic organisms. Survival and growth were measured for each test species. Results from DCR discharge areas and reference areas were very similar. The results of the testing are presented in detail in the Phase I Final EIS.

3.2.1.2 Sediment Physical Structure and Sediment Rate

The sediment environment in the Great Lakes is the component of the Great Lakes ecosystem most susceptible to potential impacts from discharging DCR. This is because the DCR particles are much denser than water and are quickly deposited and incorporated into the sediments. Once in the sediments, the DCR particles have the potential to alter the physical and chemical nature of the sediments and thus affect the biota and ecological processes associated with the sediments.

The potential for DCR to affect the lake system is related to the amount of native sediment that settles out of the water column to the lake bottom over a certain period. The greater this sedimentation rate, the greater the burial and dilution rates of DCR, because as natural sediment accumulates on the lake bottom, it creates a layer over the deposited DCR. The concentration of DCR in the sediment can determine potential chemical and physical impacts on resources.

The sediment load from tributaries to the Great Lakes is a result of land use, size of the drainage basin, soil types, and other factors. Studies have shown that natural sedimentation rates are highest in Lake Erie and lowest in Lake Superior (Kemp and Harper, 1976) and that sedimentation rates are greatest near the shorelines of the Great Lakes and decrease substantially in the areas farthest offshore. This is generally because of the terrestrial, or land-based, soil particles that erode and deposit in the nearshore environment. The sedimentation rates, presented in detail in the Phase I Final EIS, are expected to continue into the future at similar rates.

3.2.1.3 DCR Deposition Rate

Dry cargo transport and discharging DCR has been occurring on the Great Lakes for over 100 years. The Phase I EIS describes and analyzes the amount, type, and distribution of DCR discharges in detail. Based on the reported data on DCR discharges as detailed in the Phase I Final EIS, a range of deposition rates (less than 1 pound per acre to 6.5 pounds per acre per year) representing discharge practices throughout the Great Lakes was identified and selected areas were identified for additional examination. Underwater video, sidescan sonar, and grab sampling of approximately the upper 6 inches of sediment occurred along survey lines which were oriented along shipping lanes. Based on these initial surveys, several perpendicular survey lines were run to identify the potential lateral extent of deposition. These surveys suggested that DCR discharge rates vary greatly and that historical shipping practices resulted in a widespread distribution of DCR across the lake bottom.

The DCR material appears to be concentrated in the shipping lanes, but in several areas (particularly Lakes Michigan and Superior), sonar images indicate DCR is deposited several miles outside of the navigational chart shipping lanes.

3.2.2 Water Quality

The water quality of the Great Lakes, as described in the Phase I Final EIS, is affected by in-lake cycles, external inputs from watershed inflows, and atmospheric deposition, all of which can be influenced by human activities. Human activities provide much of the input through wastewater discharges, energy production, chemical spills, road salt usage, and other sources.

The State of the Lakes Ecosystem Conference (SOLEC) reviewed the state of the Great Lakes after the 2004 conference and produced a summary of the main stressors on each of the Great Lakes, on Lake St. Clair, and on the St. Lawrence River. SOLEC (2005) concluded that the most important factors affecting water quality in each lake were the following:

- Lake Superior: chemical contamination, shoreline development, and wetlands loss and degradation
- Lake Michigan: habitat alteration
- Lake Huron: chemical contamination and poor coastal health
- Lake Erie: land-use practices, non-native species, nutrient inputs, and chemical and biological contaminants
- Lake Ontario: non-native invasive species, contamination, and urbanization

3.2.2.1 Water Chemistry

Toxic contaminants enter the Great Lakes through point and nonpoint sources. These sources include tributaries and atmospheric deposition, which are regional and global in origin. Increased development within areas draining to the Great Lakes has resulted in increased volumes of stormwater runoff, which is contaminated from municipal, agricultural, and industrial sources. Atmospheric deposition of persistent organic pollutants such as polycyclic aromatic hydrocarbons (PAHs) also has affected the Great Lakes water quality and fisheries. Large urban and industrial areas are a major source of these pollutants.

3.2.2.2 Dissolved Oxygen

Dissolved oxygen is an important indicator of a water body's ability to support desirable aquatic life, with low levels of dissolved oxygen typically indicating excessive growth of aquatic plants and algae, or "nutrient enrichment." Oxygen depletion is a persistent problem, mainly in the central basin of Lake Erie. Dissolved oxygen concentrations are very low at some locations and depths, with the worst conditions in August and September. The duration of oxygen depletion in Lake Erie has improved and is shorter than in the mid-1980s. However, dissolved oxygen concentrations in Lake Erie are still depleted to stressful levels (less than 4 mg/L) during late summer.

3.2.2.3 Nutrient Enrichment

Nutrient enrichment trends include the observation of nitrate and nitrite, reactive silica, phytoplankton, phosphorus, chlorophyll *a*, and water clarity. Nutrient enrichment can lead to excessive growth of aquatic plants and algae which could affect water quality adversely. Overgrowth of aquatic plants can alter aquatic habitat, reduce dissolved oxygen and cause foul odors and taste.

The trophic state of a lake is a classification system indicating the relative clarity and biological activity occurring in a lake, both of which are tied to nutrient enrichment. At one end of the continuum are oligotrophic lakes, which have cool, clear, low-nutrient characteristics, and at the other end are eutrophic lakes, which are characterized as warm, cloudy, and having high levels of nutrients and biological activity and low levels of dissolved oxygen. None of the Great Lakes are classified as eutrophic, the western basin of Lake Erie is classified as mesotrophic (between oligotrophic and eutrophic), and Lake Ontario and the central basin of Lake Erie have characteristics of both oligotrophic and mesotrophic lakes.

3.2.3 Biological and Related Resources

Biological resources consist of plants and animals and their habitats. These biological resources are intrinsically valuable, but they also provide essential aesthetic, recreational, and socioeconomic benefits. The integrity of biological resources depends on the continued presence of sensitive resources that may be particularly susceptible to environmental stresses, suitable sediment and water quality to support biological resources, and the potential for contaminants to accumulate in the food web. This section focuses on the resources that are susceptible to change from DCR discharges, are important to the function of the ecosystem, are of special societal importance, or are protected under Federal or State law or statute.

3.2.3.1 Special-Status Species

Under the Endangered Species Act (1973), threatened and endangered species and the ecosystems they depend on to survive are conserved and protected. “Endangered” means that a species is in danger of extinction in the near future throughout all or most of its geographic range. A “threatened” plant or animal species is likely to become endangered if it is not protected. Since even small effects to a few individuals of such species can affect the entire population, both regulations and sound science dictate that potential interaction between DCR discharges and these species be examined as part of the NEPA process.

One Federally listed endangered species, the northern riffleshell (*Epioblasma torulosa rangiana)* occurs in the Great Lakes (Lake Erie). Thirty species of State-listed threatened or endangered fish exist in the Lakes (Table 3-1).

TABLE 3-1
State-Listed Threatened or Endangered Fish Species Found in the Great Lakes

Common Name	Taxonomic Name	Lakes Where Present	Status
Illinois			
Banded killifish	*Fundulus diaphanus*	Michigan	Threatened
Blackchin shiner	*Notropis heterodon*	Michigan	Threatened
Blacknose shiner	*Notropis heterolepis*	Michigan	Endangered
Greater redhorse	*Moxostoma valenciennesi*	Michigan	Endangered
Iowa darter	*Etheostoma exile*	Michigan	Threatened
Lake herring	*Coregonus artedi*	Michigan	Threatened
Lake sturgeon	*Acipenser fulvescens*	Michigan	Endangered
Longnose sucker	*Catostomus catostomus*	Michigan	Threatened
Northern madtom	*Noturus stigmosus*	Michigan	Endangered
Pugnose shiner	*Notropis anogenus*	Michigan	Endangered
Indiana			
Lake sturgeon	*Acipenser fulvescens*	Michigan	Endangered
Michigan			
Channel darter	*Percina copelandi*	Huron, Erie	Endangered
Lake herring	*Coregonus artedi*	Huron, Michigan, Erie, Superior	Threatened
Lake sturgeon	*Acipenser fulvescens*	Huron, Michigan, Erie, Superior	Threatened
Mooneye	*Hiodon tergisus*	Erie	Threatened
Northern madtom	*Noturus stigmosus*	St. Clair	Endangered
Pugnose minnow	*Opsopoeodus emiliae*	St. Clair, Erie	Endangered
Pugnose shiner	Notropis anogenus	Not Identified	Endangered
River darter	*Percina shumardi*	Huron	Endangered
Sauger	*Sander canadensis*	Huron, Michigan, Erie	Threatened
Shortjaw cisco	*Coregonus zenithicus*	Huron, Michigan, Superior	Threatened
Minnesota			
None			
New York			
Deepwater sculpin	*Myoxocephalus thompsoni*	Ontario, Erie	Endangered
Eastern sand darter	*Ammocrypta pellucida*	Erie	Threatened
Lake chubsucker	*Erimyzon sucetta*	Erie	Threatened
Lake sturgeon	*Acipenser fulvescens*	Ontario, Erie	Threatened
Mooneye	*Hiodon tergisus*	Erie	Threatened
Pugnose shiner	*Notropis anogenus*	Ontario	Endangered
Round whitefish	*Prosopium cylindraceum*	Ontario	Endangered
Silver chub	*Macrhybopsis storeriana*	Erie	Endangered
Ohio			
American eel	*Anguilla rostrata*	Erie	Threatened
Blackchin shiner	*Notropis heterodon*	Erie	Endangered

TABLE 3-1
State-Listed Threatened or Endangered Fish Species Found in the Great Lakes

Common Name	Taxonomic Name	Lakes Where Present	Status
Blacknose shiner	*Notropis heterolepis*	Erie	Endangered
Greater redhorse	*Moxostoma valenciennesi*	Erie	Threatened
Lake herring	*Coregonus artedi*	Erie	Endangered
Lake sturgeon	*Acipenser fulvescens*	Erie	Endangered
Longnose sucker	*Catostomus catostomus*	Erie	Endangered
Pugnose shiner	*Notropis anogenus*	Erie	Endangered
Spotted gar	*Lepisosteus oculatus*	Erie	Endangered
Pennsylvania			
Bigmouth buffalo	*Ictiobus cyprinellus*	Erie	Endangered
Black bullhead	*Amerius melas*	Erie	Endangered
Brindled madtom	*Noturus miurus*	Erie	Threatened
Eastern sand darter	*Ammocrypta pellucida*	Erie	Endangered
Lake herring	*Coregonus artedi*	Erie	Endangered
Lake sturgeon	*Acipenser fulvescens*	Erie	Endangered
Longnose sucker	*Catostomus catostomus*	Erie	Endangered
Redfin shiner	*Lythrurus umbratilis*	Erie	Endangered
Spotted gar	*Lepisosteus oculatus*	Erie	Endangered
Tadpole madtom	*Noturus gyrinus*	Erie	Endangered
Warmouth	*Lepomis gulosus*	Erie	Endangered
Wisconsin			
Greater redhorse	*Moxostoma valenciennesi*	Michigan	Threatened
Pugnose shiner	*Notropis anogenus*	Michigan	Threatened
Skipjack herring	*Alosa chrysochloris*	Michigan	Endangered

Sources: New York DEC (2011); Michigan DNR (2011); Illinois Endangered Species Protection Board (2011); Indiana DNR (2011); Ohio DNR (2011); Pennsylvania Fish and Boat Commission (2011); Minnesota DNR (2011); Wisconsin DNR (2011).

3.2.3.2 Protected and Sensitive Areas

There are two types of protected and sensitive areas throughout the Great Lakes: those designated for protection or management by State or Federal agencies and those identified as sensitive habitat during a multiagency and stakeholder workshop on managing DCR (Reid and Meadows, 1999). Descriptions for those areas not previously identified in the workshop have been compiled from agency and other relevant Web sites. Information on the protected and sensitive areas is summarized in Table 3-2; additional information is provided in the Phase I Final EIS. The letter designations in this section correspond to those in Figure 3-1.

TABLE 3-2
Protected and Sensitive Areas

Lake	Map ID[a]	Name	Notes
Designated or Managed Areas			
Superior	A	Isle Royale National Park	Total area of 850 square miles, in northwestern section of Lake Superior with 99 percent of the land area as Federal wilderness. Park boundary extends 4.5 miles out into Lake.
	B	Apostle Islands National Lake Shore	On the tip of Bayfield Peninsula in northern Wisconsin. Includes 21 islands and a 12-mile narrow strip of mainland shoreline. Total area encompasses 69,372 acres.
	C	Whittlesey Creek National Wildlife Refuge	Part of a large wetland complex on the lake. Purpose is to protect, restore, and manage the lower portion of Whittlesey Creek and coastal wetlands along the lakeshore of Chequamegon Bay. Up to 540 acres of coastal wetland in the watershed will be acquired.
	D	Huron National Wildlife Refuge	Eight islands with the designation of a Wilderness Area. The 147-acre refuge was established for the protection of migratory birds, specifically, a large nesting colony of herring gulls.
	E	Pictured Rocks National Lake Shore	On the south-central shore of Lake Superior, along the central upper peninsula of Michigan. Encompasses 71,397 acres of land including 42 miles of shoreline.
	—	Grand Portage National Monument	Land-based park.
Michigan	F	Michigan Islands National Wildlife Refuge	Comprises eight islands in Lakes Michigan and Huron, created to protect breeding grounds for migratory birds and other wildlife.
	G	Sleeping Bear Dunes National Lakeshore	In northern Michigan on the Leelanau Peninsula. Encompasses 111 square miles and 64 total miles of coastline.
	H	Indiana Dunes National Lakeshore	Park spans 15 miles of lake shoreline between Michigan City and Gary, IN. Includes 15,060 acres.
	I	Milwaukee Mid- Lake Protection Area	Area is defined in the IEP.
	J	Northern Lake Michigan Lake Trout Refuge	Shallow reefs broadly discussed in the IEP. Is protected for restoration for Lake Michigan lake trout.

TABLE 3-2
Protected and Sensitive Areas

Lake	Map ID[a]	Name	Notes
Huron	K	Harbor Island National Wildlife Refuge	695-acre island off the northwest shore of Drummond Island in Potagannissing Bay. Hosts a variety of habitats and wildlife.
	L	Thunder Bay National Marine Sanctuary	Nationally significant collection of shipwrecks and other maritime heritage resources off NE coast of Michigan's Lower Peninsula. Encompasses 448 square miles.
Erie	M	Detroit River National Wildlife Refuge	Islands, coastal wetlands, shoals, and waterfront lands along 48 miles of the Detroit River and Western Lake Erie shoreline. Encompasses 4,982 acres.
	N	Cedar Point National Wildlife Refuge	2,445 acres of marsh, providing stopover habitat for migratory birds.
	O	Ottawa National Wildlife Refuge	Three refuges comprising approximately 9,000 acres of habitat, to preserve resting habitat for migrating birds.
	P	West Sister Island National Wildlife Refuge	In the western basin of Lake Erie, managed to provide nesting habitat for the largest heron/egret rookery in the U.S. Great Lakes.
	Q	Old Woman Creek National Estuarine Research Reserve	571-acre reserve on the south-central shore of Lake Erie in Ohio.
Other Sensitive Habitats			
Superior	R	Caribou Island and Southwest Protection Area	Area is defined in the IEP. Includes fish spawning and nursery grounds.
	S	Stannard Rock Protection Area	Area is defined in the IEP. Is an offshore fish-spawning reef.
	T	Superior Shoal Protection Area	Area is defined in the IEP. Is an offshore fish-spawning reef.
Michigan	U	Waukegan Protection Area	Area is defined in the IEP.
	V	Green Bay	Area is defined in the IEP, as sensitive fish habitat.
Huron	W	Saginaw Bay	Area is defined in the IEP.
	X	Six Fathom Scarp Mid-Lake Protection Area	Area is defined in the IEP.
Erie	Y	Western Basin	Area is defined in the IEP. Includes sensitive habitats associated with islands and reefs.

[a]See Figure 3-1.

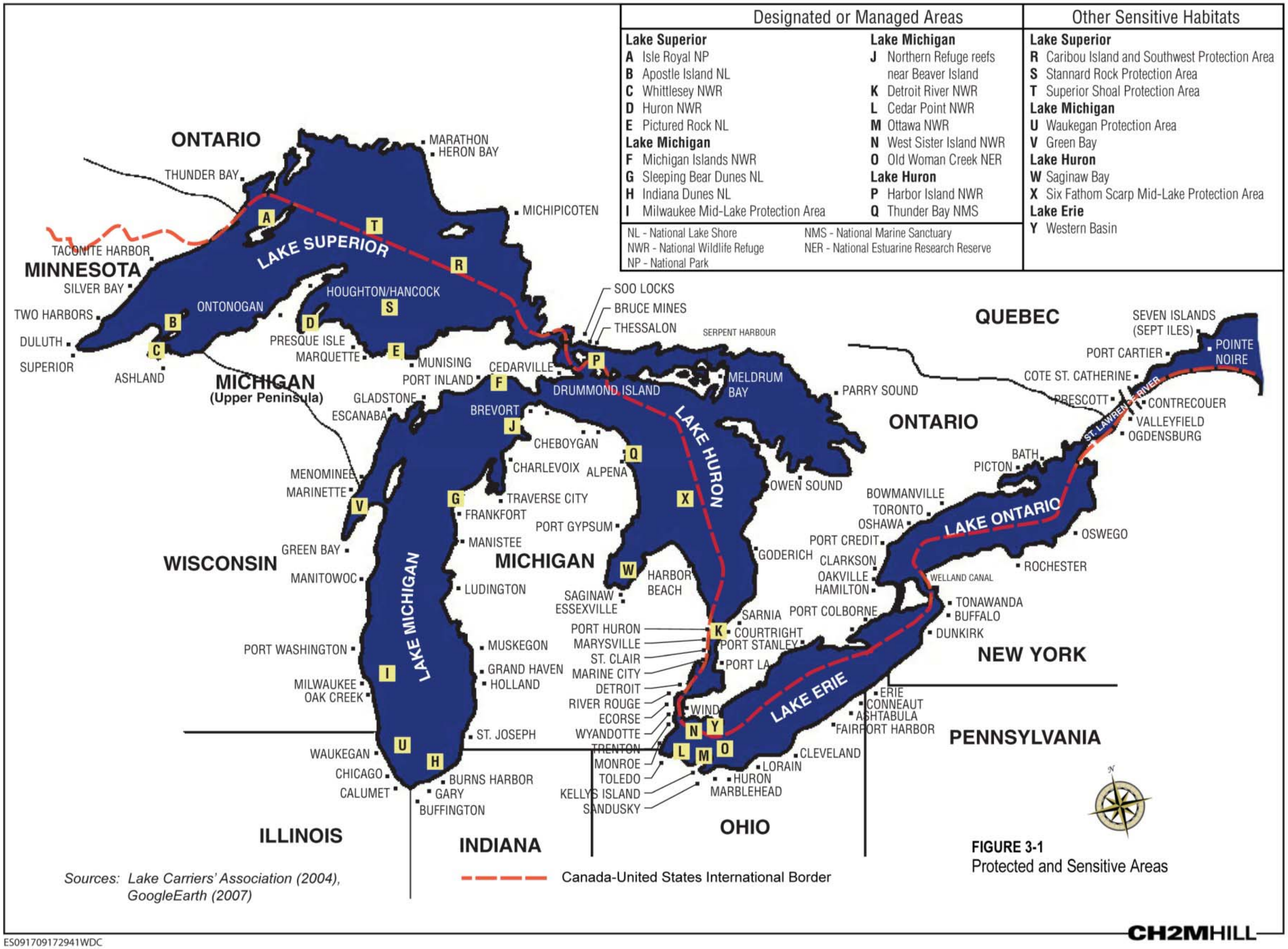


FIGURE 3-1
Protected and Sensitive Areas

3.2.3.3 Benthic Community

A benthic community is an assemblage of organisms that live in and on the sediments at the bottom of a body of water. DCR discharges are much denser than water and are quickly deposited and incorporated into sediments where the benthic community resides. Once in the sediments, the DCR discharges have the potential to alter the physical and chemical nature of the sediments (that is, the habitat for benthic organisms) and thus potentially affect the benthic invertebrate community through changes in the sediment quality and possibly by smothering the community.

Over the last 10 years, benthic invertebrate populations have undergone major changes in nearshore and offshore regions of the Great Lakes. Many of these changes can be attributed to the widespread distribution and great abundances of the invasive dreissenid mussels, the zebra mussel and quagga mussel (Nalepa et al., 1991; International Association for Great Lakes Research, 2002).

Benthic community structure data were collected from the same sediment samples described in Section 3.2.1.1—two in Lake Superior, one in Lake Michigan, and two in Lake Erie. (The sampling and results are detailed in the Phase I Final EIS and in Appendix H of that document.)

Although interpretation of the data is limited by the small sample size and the potential for seasonal variations, data collected from Lake Superior indicated that the benthic community structure in DCR sweeping discharge areas is similar to that of the reference areas.

In Lake Michigan, benthic community measures were higher in abundance of freshwater clams (Family Sphaeriidae) and diversity in the DCR sweeping discharge area relative to the reference area but lower when measured by total organism abundance and aquatic worm abundance in the DCR sweeping discharge area relative to the reference area. Taxa richness, which is a measure of organism types, was in the range previously measured by EPA (2007), but total organism abundance was higher than that observed by EPA.

In Lake Erie, little difference was observed in the benthic community measures between the DCR discharge and reference areas. This may be the result of many factors, including nutrient enrichment and a large mussel (Family Dreissenidae) population, which can significantly alter the lake bottom.

Benthic community evaluations performed by others in Lake Ontario observed differences in the composition of species found in DCR discharge areas compared to reference areas. These differences were potentially attributed to physical disturbance of the sediments, contaminant effects, and coarsening and de-enrichment of sediment.

The Great Lakes Water Quality Agreement of 1978 calls for the use of the small, shrimp-like amphipod *Diporeia* spp. as an indicator of the biological integrity of the offshore regions of the lakes. As described in the Phase I Final EIS, data indicate that some areas of the Great Lakes already are below the *Diporeia* spp. goal (220 to 320 amphipods per square meter), and *Diporeia* spp. densities are quickly declining in other areas. Continued declines in *Diporeia* spp. density could adversely affect the biological integrity of the Great Lakes.

3.2.3.4 Fish and Other Pelagic Organisms

Fish and other pelagic organisms such as plankton inhabit the pelagic zone, which is defined as that part of the open lake that is not near the shoreline or lake bottom. DCR discharged from vessels will pass through the pelagic zone, and potentially affect animals living in this zone by changes in physical conditions or water quality. Fish also are associated with the lake bottom because either they feed on benthic invertebrates or they spawn at or near the lake bottom, or both. As such, DCR discharges settling near the lake bottom could affect fish habitat.

Many native fish species have been lost over the past 100 years because of overfishing, pollution, invasions by non-native species, and natural changes. As of summer 2010, a recent wave of invasive species has caused damage to the quality and character of Lake Huron by evidence of permanent changes in the food web (Michigan.gov, 2010). In Lake Erie, some fish populations have fluctuated, drastically falling and rising due to nutrient problems in the lake. There has also been progress in the rehabilitation of some native fish stocks. Lake Superior boasts completely rehabilitated populations of lake trout despite the establishment of invasive species populations that have disrupted the food web. In general, some data collected to study the general health of the Great Lakes show remarkable improvements (MDEQ, 2012). Other data however, especially those that relate to invasive species and their effects on the health of the aquatic food web, show considerable signs of stress on the Great Lakes (MDEQ, 2012).

Spawning and nursery habitats represent sensitive environments of limited distribution and are necessary to maintain fish populations. Species that use shoreline areas and deeper waters as spawning and nursery areas are more susceptible to DCR discharges than those that use riverine habitats.

Pelagic and planktonic organisms reside within the water column and consist primarily of phytoplankton (microscopic single-celled plants) and zooplankton (microscopic animals). Phytoplankton and zooplankton could be adversely affected by chemicals released into the water column by DCR discharges. Phytoplankton also could be affected if DCR discharges were to increase the concentrations of nutrients that phytoplankton rely on for growth and survival. This could result in an increased phytoplankton population, which also could adversely affect water quality.

Studies described in the Phase I Final EIS determined the seasonality of biomass and various taxonomic groups of phytoplankton show differentiation between individual lakes. The Lower Great Lakes (Erie and Ontario) were found to harbor eutrophic and mesotrophic species, and the Upper Great Lakes harbored oligotrophic species, which are indicative of few nutrients, little organic matter, and a high dissolved oxygen level.

3.2.3.5 Invasive Mussel Species

There is potential for discharged DCR to provide substrates for the colonization of the invasive zebra mussel and quagga mussel in the Great Lakes. The realization of this potential depends largely on the species’ environmental requirements and life history.

Temperature, calcium, pH, dissolved oxygen, and depth are important factors governing the survival and distribution of the mussels. Substrate type may be one of the most critical factors for the mussels, in general, and particularly in relation to DCR because the physical characteristics of the substrate can be altered by the discharging of DCR. Juvenile and adult zebra mussels are epifaunal—that is, they typically reside at the sediment–water interface—and generally are anchored to the substrate (Karatayev et al., 1998). They are most abundant on hard surfaces (Mellina and Rasmussen, 1994), particularly rocky surfaces.

Once zebra mussels become established in an area, juveniles may colonize old shell. This can result in expansion onto adjacent soft substrates such as sand, mud, and gravel (Hunter and Bailey, 1992; Berkman et al., 2000). Although zebra mussels appeared first in the Great Lakes, it seems that the quagga mussel is now replacing the zebra as the dominant species most likely because of their ability to colonize on both hard and soft substrates.

Discharged DCR may provide enhanced substrate for the colonization of invasive mussel species in the Great Lakes, depending on the suitability of other environmental conditions.

Zebra and quagga mussels have caused major ecological and economic problems since their arrival in North America. They can accumulate organic pollutants in their tissues to concentrations more than 300,000 times greater than those concentrations in the environment. These pollutants can be passed up the food web and increase wildlife exposure to organic pollutants (Snyder et al., 1997). Another major threat involves the fouling of native freshwater mussels.

The ability to rapidly colonize hard surfaces causes serious economic problems related to organisms clogging water intake structures, such as pipes and screens, which reduce pumping capabilities for power and water treatment plants. Recreation-based industries and activities have also been affected; docks, breakwalls, buoys, boats, and beaches have all been heavily colonized.

In 1992 quagga mussels greatly outnumbered zebra mussels only in the eastern basin of Lake Erie, but now the entire lake is dominated with quagga mussels (Mills et al., 1993; Patterson et al., 2002). An area of periodic summer anoxia is the only region of the basin that has not been colonized with *Dreissena* (Dermott and Munawar, 1993). Nearshore localized anoxia is possible in Lake Michigan and may account for the absence of *Dreissena* near Michigan City (Bunnell, 2007). Currently, Lake Superior does not have a large *Dreissena* invasion. No quagga mussels were observed in Lake Superior in a 2002 survey; however, they were observed in 2005 and in 2007, as expected, due to their ability to spawn at lower temperatures and their low food supply needs (Grigorovich et al., 2003; EPA, 2007; Benson and Raikow, 2007).

3.2.3.6 Waterfowl

More than 100 species of birds are estimated to be either totally or partially dependent on the Great Lakes basin wetlands (Environment Canada, 2007), most of which are protected under the Migratory Bird Treaty Act (MBTA) of 1918. Birds found in the Great Lakes include ducks, shorebirds, gulls and terns, herons and egrets, geese (*Branta* spp.) swans (*Cygnus* spp.), and raptors (GLIN, 2007a). Other birds not contained in these major groups include coots (*Fulica americana*), grebes, and moorhens (*Gallinula chloropus*) (GLIN, 2007a). The sandy beach areas of the Great Lakes provide excellent shorebird habitat.

Most waterfowl species (geese, swans, and ducks) are associated with the shallow water areas of the Great Lakes. Some waterfowl species are diving or deep-water-foraging, and include grebes, mergansers, cormorants (*Phalacrocorax* spp.), loons (*Gavia* spp.), and certain ducks such as the canvasback (*Aythya valisineria*), greater and lesser scaup (*Aythya marila* and *Aythya affinis*, respectively), redhead duck (*Aythya americana*), and ring-necked duck (*Aythya collaris*). These species feed primarily on fish and mussels, although water depth limits the areas within which they can forage. Only a few of these species, such as the cormorant, forage in offshore areas, at depths generally less than 30 feet, but up to 70 feet deep (Palmer, 1962). These areas may coincide with DCR sweeping discharge areas.

3.2.4 Socioeconomic Environment

For purposes of the Tiered Final EIS, the socioeconomic environment is defined to include the following economic sectors: the dry bulk carrier industry, shipping-dependent industries, port facilities, and commercial fishing. It also describes the infrastructure that supports these water-dependent sectors of the economy.

3.2.4.1 Economic Sectors

The dry bulk carrier industry is important to the economy of the Great Lakes region by providing raw materials and supplies and transporting parts and final products to industry and end users. The industry operates at a low profit margin, suggesting that it is sensitive to changes in regulatory requirements with high compliance costs (USACE, 2009). Paradoxically, shipping costs save the using industries about $3.6 billion a year over the least costly alternative (TVA, 2005; USACE, 2009).

TABLE 3-3
Great Lakes Rate Savings Benefits

Commodity	Fiscal Year 2008 Savings per Ton (Oct. 2008 Dollars)	Thousands of Tons (Commodity Year 2006)	Rate Savings Benefit[a] (Dollars)
Wheat	24.02	1,636	39,298,492
Maize	32.17	1,875	60,326,942
Soybeans	30.60	1,161	35,531,916
Other grains and seeds	39.48	2,066	81,570,722
Limestone	21.78	30,908	673,091,214
Other minerals	26.78	7,239	193,848,497
Ores (including iron ore)	12.89	58,848	758,635,652
Coal	18.05	44,896	810,365,445
Petroleum products	27.43	5,067	139,012,440
Cement	46.00	7,151	328,946,909
Miscellaneous	42.73	12,166	519,808,956
Total		173,013	3,640,437,183

Sources: Strum (2008); TVA (2005).

TABLE 3-3
Great Lakes Rate Savings Benefits

Commodity	Fiscal Year 2008 Savings per Ton (Oct. 2008 Dollars)	Thousands of Tons (Commodity Year 2006)	Rate Savings Benefit[a] (Dollars)

[a]Commodity year 2006 Great Lakes waterborne commerce; October 2008 price level.

As shown in Table 3-3, for commodity year 2006, most of these cost savings (in fiscal year 2008 dollars, or the October 2008 price level) are attributed to coal ($810 million); ores, including iron ore ($759 million); and limestone ($673 million). The commodity year for Great Lakes waterborne purposes corresponds to the weather-dependent shipping season, which generally starts on or around April 1 and ends on or around December 31.

At first glance, such large cost savings would suggest that the bulk carriers could pass on any increased costs to their users such as the steel, construction, and automobile industries. However, it is precisely the favorable shipping costs associated with the dry bulk carriers that supported the initial development and the continuation of these industries in the highly competitive global economy (USACE, 2009). Therefore, the dry bulk carriers are limited in terms of their ability to pass on higher costs to their users.

The limited ability of dry bulk carriers to absorb higher costs also has implications for the viability of individual ports and the interdependent system of ports. That is, if bulk carriers remove vessels from service or go out of business, it will potentially affect other ports in the system, with potential adverse economic consequences for the Great Lakes navigation system (USACE, 2009).

Dry Bulk Carrier Industry. As described in Section 1.7, the dry bulk cargo industry in the Great Lakes is made up primarily of U.S. and Canadian lakers. Maritime transport (e.g., ports, shippers, longshoremen) in the Great Lakes navigation system employs about 44,000 people (Martin Associates, 2001; USACE, 2009). However, direct U.S. employment by the dry bulk carriers, both on the vessel and in the office, is approximately 2,500, as estimated by the Lake Carriers Association (Nekvasil, 2009).

The number of vessels in the U.S. Great Lakes dry bulk cargo fleet has gradually been reduced over time and remains around 55 vessels. However, the actual number of vessels plying the lakes in any given year is a function of economic conditions in the steel, electric utility, and construction industries and the subsequent derived demand for bulk cargoes of iron ore, coal, and limestone. Most companies operate using contractual arrangements with clients to carry a range of freight volume each year with some additional spot business. The contracts are usually two to three years long. As such, companies plan before the shipping season begins on how many vessels will be active and how many will remain in dry dock.

Four trends that define the current industry have been a decrease in "vertical integration"—when a firm owns its upstream suppliers and controls its inputs to a greater degree—an increase in horizontal integration, the recent consolidation of firms, and the use of self-unloading, articulated tug barges (ATBs). ATBs are a tug and barge joined by a flexible connection to operate as a single unit. Throughout the 1950s and 1960s, many of the large vessels were vertically integrated within the steel industry and owned and managed by the steel companies. Those companies then sold off those assets to companies within the transportation sector, which caused the industry to become more horizontally integrated.

In 1973, GATX, a large U.S. railroad company, acquired American Steamship Company (ASC). ASC remains the largest U.S. firm in the Great Lakes dry bulk cargo industry, with 18 self-unloading vessels. In 2004, Canadian National, the largest Canadian railroad, acquired eight self-unloading vessels, which now operate through a U.S. holding company and are regulated as U.S. vessels. Prior to that, the assets of Great Lakes Fleet, along with railroad and mining assets, were owned by U. S. Steel Corporation.

In 2006, Rand Logistics acquired and consolidated the assets of Lower Lakes Towing in Canada and Lower Lakes Transportation in the United States. Seven of the vessels are in the U.S. fleet.

Using self-unloading ATBs appears to be how the industry is responding to vessel capital replacement within the constraints of the Jones Act, which requires that goods transported by water between U.S. ports be carried by U.S. vessels constructed in the U.S., owned by U.S. citizens, and crewed by the same. This trend in technology uses older dry bulk carrier steamships and converts them to notched, articulated barges. The barges are paired with a tug. Two such barges were purchased as steamships and converted to ATBs in 2006 and 2007. Both are now fully operational as ATBs, which are claimed to have increased efficiencies and overall operations.

The bulk dry carrier industry operates at a low profit margin and thus is sensitive to economic conditions and has a limited ability to absorb higher costs.

Using publicly available financial documents and various vessel owner reports from Dun and Bradstreet (2009), total revenues within the industry are estimated at $600 million (2008 dollars). Average revenues per vessel range from $7.7 million to $15.1 million, depending upon the firm. The year-to-year differences in a firm's revenues can vary greatly depending upon economic conditions affecting demand and vessel-operating costs. Net revenues—total revenues minus operating and maintenance costs—have recently ranged from 7 to 15 percent of revenues. Again, the variance within a firm can be just as great, depending upon that year's economic condition.

U.S. Great Lakes Shipping–Dependent Industries. Tonnage carried by the U.S. fleet of dry bulk carriers averaged almost 106 million tons per year over the 2000 to 2006 period. This compares with 173 million tons of commodities in total that were transported to and from U.S. ports within the Great Lakes system (USACE, 2009). The steel industry, and thus the auto manufacturers, developed in this region, in part, due to the ability to transport bulk materials by vessel. Taconite accounts for the greatest tonnage. In the present day, more than 80 percent of the iron ore (or taconite) used in the U.S. steel industry is transported within the Great Lakes navigation system (USACE, 2009).

Limestone is second in tonnage, and is primarily used in steel making and aggregate for construction. From Table 1-3, coal carriage ranks third and includes the immense amounts that are transported from Montana and Wyoming through Lake Superior and to ports in Lake Michigan and Lake Erie to power-generating stations in many metropolitan areas of the Great Lakes (USACE, 2009). By 2050, tonnage on the Great Lakes navigation system is projected to increase between 25 and 30 percent (Transport Canada et al., 2007; USACE, 2009).

The mining, steel, and energy industries are the primary customers of the Great Lakes dry bulk cargo waterborne carriers. The U.S. Army Corp of Engineers (USACE, 2009) estimates that in 2000, over 54,000 jobs in the mining industry and 138,000 jobs in the steel industry are dependent on the Great Lakes navigation system (USACE, 2009; Martin Associates, 2001; American Iron and Steel Institute Report, 2000). These figures do not include the region's other major industries, such as automobile manufacturing, heavy machinery, paper production, metalworking, and shipbuilding. There is interdependence among these other industries and those supported directly by the dry bulk cargo.

Port Facilities. U.S. vessels operate out of roughly 70 ports in Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York, with the greatest number of ports, 40, in Michigan. Canadian vessels operate out of 35 ports in Ontario and Quebec, with most of those ports in Ontario.

USACE (2009) estimates that the smallest ports handle less than 1 million tons of cargo per year, and the largest over 45 million tons per year, based on data for the years 2000 through 2008. This places some of the harbors within the top 100 U.S. harbors by tonnage. Unlike ports along the eastern and western U.S. coasts, these ports ship to and from each other in a complex pattern of interdependency rather than compete against each other. This means that the long-term viability of each port is threatened by weakening economic viability of the other ports in the system. A loss of vessel traffic can affect more than the couple of ports used by a particular vessel, as the tonnage for the entire Great Lakes navigation system would fall.

As mentioned above, the Great Lakes maritime transport industry employs about 44,000 people, with only a small fraction holding jobs in the dry bulk carrier industry; the majority of these work at ports and in liquid bulk and container shipping. Furthermore, based upon a study conducted by Martin Associates (2001), the USACE (2009) reports that the U.S. ports within the Great Lakes navigation system generated about $3.4 billion dollars of revenue and paid $1.3 billion in Federal, State, and local taxes in 2001 (USACE, 2009; Martin Associates, 2001).

Most port facilities are private; the seven U.S. operators (companies) in the 2005 MARAD survey collectively stated that 85 percent of their cargo was loaded and 93 percent was unloaded at private (customer-owned) port facilities (MARAD, 2005). Major elements of the port facilities that relate to bulk dry cargo are the storage, materials-handling systems, and procedures for loading and unloading the vessels, described in Section 1.7.

Commercial and Sport Fishing. The commercial fishery on the Great Lakes is valued at more than $1 billion annually, and the sport fishery at more than $4 billion annually. The commercial fishery harvests about 65 million pounds of fish per year including whitefish, smelt, walleye, and perch. The sport fishery is a blend of native and introduced species, some of which are regularly restocked, including salmon, steelhead, walleye, lake trout, perch and bass (GLIN, 2007b). Overall trends within the Great Lakes show a decrease in fish biomass and fish density. Of all of the Great Lakes, Lake Superior has maintained a majority of its native species and during the past 20 years has undergone progress toward restoration of commercially and recreationally significant self-sustaining species. Section 3.2.3.4, Fish and Other Pelagic Organisms, further summarizes Great Lakes fish species and fisheries.

3.2.4.2 Water-Dependent Infrastructure

Infrastructure is the foundation that supports most economic activity. Water-dependent infrastructure relating to the dry bulk cargo industry chiefly includes maintained channels, as described in the Phase I Final EIS, and ports, also described in the Phase I Final EIS and above. Water dependent infrastructure is most affected by public and private investment in new projects and improvements, as well as maintenance expenditures. The Great Lakes dry bulk carrier industry expects that public investment will be directed toward navigation locks and dams in the next 5 years, whereas most if not all new investment for loading equipment, storage capacity, and docks will come from the private sector (MARAD, 2005).

USACE (2009) estimates annual navigation infrastructure operation and maintenance costs exceeding $200 million (Table 3-4). These include maintenance dredging, additional dredging to address the backlog in dredge material that has accumulated, confined disposal facilities (CDFs) and dredge material management plans (DMMPs), breakwater preventive maintenance and rehabilitation, Soo Locks asset renewal, and other navigation operations and maintenance costs. Such expenditures on maintaining navigation infrastructure are needed to support the Great Lakes navigation system, of which the dry bulk carrier industry is an integral part.

TABLE 3-4
Great Lakes Navigation System Operations and Maintenance Costs for Fiscal Years 2009–2013 (Commercial Harbors)

	Projected Operations and Maintenance Costs ($000s)						
Fiscal Year	**Maintenance Dredging**	**Backlog Removal**	**CDFs & DMMPs**	**Breakwater Prevention Maintenance & Rehabilitation**	**Soo Locks Asset Renewal**	**Other Navigation[a]**	**Total**
2009	40,200	41,600	32,000	47,700	12,900	39,000	213,400
2010	41,000	42,400	26,000	48,500	12,300	39,800	210,000
2011	42,000	43,200	14,000	49,500	19,000	50,300[b]	218,000
2012	42,800	44,200	38,000	50,700	9,900	41,200	226,800
2013	43,700	45,000	33,000	52,000	8,300	42,400	224,400

Source: USACE (2009, p.17).
[a] Includes routine operation and maintenance of locks, surveys of project conditions, environmental activities, support of real estate, support of staff.
[b] Includes $10 million for new gates at Chicago Lock.

CHAPTER 4

Environmental Consequences

4.1 Introduction

This chapter discusses the potential for, and significance of, environmental and economic consequences associated with implementing any of the project alternatives—including the No Action alternative—described in Chapters 1 and 2. The No Action alternative represents the interim rule resulting from the Phase I Final EIS. The two additional alternatives being considered, Performance Requirement to Minimize DCR (Alternative 2) and Prescriptive Requirement for Baseline Control Measures (Alternative 3) generally will result in a reduced quantity of DCR discharge from the combined Great Lakes fleet.

In this Tiered Final EIS, the impact assessment process builds on the evaluation of alternatives and impact assessment undertaken for the Phase I Final EIS. It is also based on discussion in Chapter 3 of the affected environment for the entire Great Lakes system as well as site-specific data collected in the geographic areas most affected by past—and most likely to be affected by future—DCR discharge activity. The impact evaluation focuses on those resource categories previously identified as having some level of environmental or economic impact. The influence of discharges under existing conditions is similar to the influence of discharges under the No Action alternative because DCR discharging has been occurring in the Great Lakes for over a century.

In most cases, where no impacts were previously determined, potential impacts under the Tiered Final EIS alternatives would be the same or less as a result of the projected reduced discharge of DCR associated with the action alternatives. For those resource categories, the Phase I Final EIS completely describes the basis for the determination of no adverse impact, and that reasoning is not repeated in this Tiered Final EIS.

However, observations conducted for this Tiered EIS revealed that under current rules (No Action alternative), which do not prohibit the discharge of limestone and clean stone DCR within 3 statute miles of shore (Appendix F), discharges can occur while vessels are stationary at loading or unloading docks, where currents and mixing are limited. Consequently, resource areas that might experience an adverse impact, as defined in Section 4.2 below, resulting from the shoreline deposition of limestone and clean stone were included in the Tiered EIS impact evaluation because of the potential effect of DCR discharged near shore, despite the fact that the Phase I Final EIS determined there to be no adverse impact. These resource categories include DCR deposition rate and invasive mussel species in lakes Ontario, Erie, and Superior.

As described in detail in Chapter 4 of the Phase I Final EIS and summarized below, in Table 4-2, impacts are categorized in terms of intensity as defined by specific impact criteria. Thus the discussion of impacts addresses changes to resource areas in terms of: no impact, insignificant or minor impacts, or significant impacts. For one resource category, protected and sensitive areas, a significant impact was identified in the Phase I Final EIS for all alternatives except No Action. With mitigation, the level of impact was reduced to less than

CHAPTER 5

Comparison of Alternatives

5.1 Introduction

Each alternative's impacts are described in Chapter 4 in comparison to the No Action alternative, which is similar to the decades of DCR discharges that have occurred under the current interim rule and under the IEP before that. In areas where discharge is permitted, the No Action alternative also substantively represents the DCR management practice that has occurred for much of the last century. This chapter presents the basis of comparison for each alternative, the relative reduction in DCR discharge by alternative, the relative cost of implementing each alternative, and the composite ranking of alternatives.

5.2 Basis of Comparison

The impact analysis is structured around significance criteria, so that an alternative can be uniformly categorized as having "no impact," an "insignificant impact," or a "significant impact." This greatly aids in comparing alternatives because impacts to different resources (for example, sediment, water quality, and biota) can be viewed on a common basis. In some cases, an alternative may be categorized as having an "impact, but less than an insignificant (minor) adverse impact," to reflect the somewhat reduced impact of one alternative compared to another. The impact criteria used to evaluate alternatives are detailed in Section 4.2.

The comparison-of-alternatives method selected for use in an EIS depends on the complexity of the impacts and the alternatives. In some complicated cases, a highly structured and quantitative method using sophisticated decision science is suitable because of the nature of available data. In other cases, a qualitative approach is more appropriate, due to more straightforward or less quantitative information. For the DCR discharge impact assessment, both the impacts and the alternatives are straightforward. The impacts are directly related to the location and quantity of DCR discharge, and the alternatives are different methods of reducing the quantity or controlling the location of discharges. Thus, consistent with the Phase I Final EIS, a qualitative basis of comparison is appropriate for this Tiered Final EIS.

5.3 Relative DCR Estimated Discharge Volume by Alternative

As described in Section 1.7, under current conditions, DCR discharge volumes have been observed to vary by cargo type, with most DCR volume originating in vessel tunnels and generated during the unloading process. Depending on cargo, the DCR discharge volume from unloading events was observed to be about two (taconite) to 10 (coal) times greater than the volume from loading events.

Vessel records for loading events and observation data for all events indicate that over 50 percent of total DCR discharge volume originated from just 3 to 7 percent of DCR discharge events, depending on cargo type. Thus most DCR volume originates from a few events; the

Over half of the volume of all DCR discharged comes from just 3–7% of the DCR discharge events.

greatest DCR control can be achieved by an alternative that effectively controls the largest DCR sources, that is, these few, large-volume events.

The DCR discharge reductions predicted for the purpose of impact evaluation are provided in Table 4-4 and summarized in Table 5-1. The volumes include a safety factor to conservatively estimate DCR discharge volumes and the impacts resulting from the DCR discharge, thus avoiding underprediction of impacts. Similarly, the predicted DCR discharge volumes reflect primarily the control of those loading and unloading events resulting in the largest volumes of DCR discharge. No reductions of the lower volume discharge events were included in the estimates used to predict impacts, although DCR amounts associated with the lower volume discharge events could also be reduced.

TABLE 5-1
Predicted Reduction in DCR Discharge Volume per Discharge Event

	1—No Action		2—Minimize DCR Discharges	3—Baseline Control Measures
	Median (ft^3)	Mean (ft^3)	Estimated DCR Volume Reduction Compared to No Action Alternative (%)	Estimated DCR Volume Reduction Compared to No Action Alternative (%)
Loading[a]				
Coal	3.4	11.6	69	56
Limestone	3.7	18.8	74	62
Taconite	3.0	19.3	77	57
Unloading[b]				
Coal	41.1	48.9	85	17
Limestone	25.1	241.2	81	40
Taconite	9.3	9.3	54	49

[a]Reductions calculated with the means because of large data set.
[b]Reductions calculated with the medians because of small data set.

The greatest DCR control and potentially least total DCR discharge volume would be achieved with the Performance Requirement to Minimize DCR Discharges alternative, which establishes a performance requirement for reducing or eliminating discharges by maintaining a "broom clean" standard on the deck and by developing and implementing a DCR discharge management plan outlining available, economically practicable, and achievable steps that the vessel takes to control DCR discharges. Compared to the No Action alternative, DCR volumes could be reduced between 69 and 77 percent during loading. In contrast, the Baseline Control Measures alternative, which requires that all vessels and shoreside loading facilities have specified control measures (or their equivalent), maintained to operate as designed would reduce DCR volumes between 56 and 62 percent compared to the

The least DCR discharge volume would be achieved through Alternative 2.

No Action alternative during loading, depending on the cargo type.

Even greater DCR control and potentially least DCR discharge volumes could be achieved by the Performance Requirement to Minimize DCR Discharges alternative during unloading. Compared to the No Action alternative, DCR discharge volumes could be reduced by an estimated 54 to 85 percent during unloading. In contrast, the Baseline Control Measures alternative could reduce DCR discharge volumes by and estimated 17 to 49 percent compared to the No Action alternative, depending on cargo type.

The Performance Requirement to Minimize DCR Discharges alternative potentially results in lower DCR discharge volumes to a greater degree than the Baseline Control Measures alternative does. This is because the Performance Requirement to Minimize DCR Discharges alternative requires vessels to develop and implement a DCR discharge management plan to reduce DCR discharge volumes using economically practicable and achievable measures. The Baseline Control Measure alternative does not reduce DCR as much because it requires the vessels and shoreside facilities only to operate and maintain the control measures without requiring them to meet a performance standard.

Both action alternatives would maintain DCR discharge exclusion areas and reduced recordkeeping requirements and require mandatory restrictions on DCR discharges in nearshore waters and other environmentally sensitive areas. With mitigation, all alternatives would eliminate DCR discharge in all port and nearshore areas and within 3 statute miles of shoreline, except for discharges in the dredged navigation channels of the Western Basin of Lake Erie for vessels that do not transit outside the Western Basin.

5.4 Relative Cost for Each Alternative

The total cost to U.S. and Canadian fleets of implementing various alternatives was estimated as described in Appendix E. The No Action alternative had no incremental costs associated with it because all of the DCR control and management equipment, procedures, and effort are associated with this alternative currently, and thus it would not require additional expenditures. A range in costs is estimated for both the Performance Requirement to Minimize DCR Discharges and Baseline Control Measures alternatives to reflect the range of equipment and DCR discharge management practices that currently exist. Some vessels could comply by making only minimal modification to their equipment and/or operational maintenance activities; others may make more extensive modifications, undertake additional operation and maintenance activity, and/or apply additional labor resources relative to current practice. The Performance Requirement to Minimize DCR Discharges alternative had costs for the low range based on (1) deck sweeping to maintain the “broom clean” standard and (2) preparation and implementation of a DCR management plan for each vessel. The costs for the high range had these costs plus costs estimated for a possible (but not required) approach to address tunnel DCR discharge. The Baseline Control Measures alternative costs were based on deck sweeping to collect DCR after loading and additional training and operational and maintenance costs. Both alternatives have a small cost savings due to a modest change in recordkeeping requirements.

On an annualized basis, the costs associated with each alternative are very small in relation to total revenue. In 2008, approximately 70 percent of the U.S. Great Lakes shipping companies generated over $470 million in revenues. The annualized pretax compliance cost as a percentage of just 70 percent of the total revenues is less than 1 percent for both the higher and lower ends of the range of costs for both the Performance Requirement to Minimize DCR Discharges and Baseline Control Measures alternatives. Consequently, no impact is predicted for either of these alternatives. Even with possible changes in annual revenues of up to 25 percent, the effect on the U.S. fleet would still be less than 1 percent and still categorized as having no impact.

For both alternatives, costs to Canadian vessels are potentially less than those to U.S. vessels. This is because a Canadian vessel could delay discharging tunnel DCR until it was outside of U.S. waters. For both U.S. and Canadian vessels, the ranges in estimated costs associated with the Performance Requirement to Minimize DCR Discharges alternative are similar to those associated with the Baseline Control Measures alternative. Based on these factors and relative to the No Action alternative, the Performance Requirement to Minimize DCR Discharges alternative and the Baseline Control Measures alternative are not appreciably different from an economic perspective.

5.5 Relative Impacts for Each Alternative and Ranking

Alternatives ranking is based on DCR reduction, relative cost, and the impact of each alternative as measured by the significance criteria. Without mitigation, the greatest environmental impacts are associated with the No Action and Baseline Control Measures alternatives, where a significant impact is predicted (Table 5-3). Impacts are reduced to an insignificant level for all resource categories in the Performance Requirement to Minimize DCR Discharges alternative, with the exception of sediment deposition rate. A significant impact would remain in the sediment deposition rate as a result of the potential discharge of DCR in port areas, although the greater level of DCR control associated with this alternative would reduce the discharge relative to the Baseline Control Measures alternative. The reduced impacts associated with the Performance Requirement to Minimize DCR Discharges alternative are a direct result of the greater reduction of DCR discharges associated with the requirement to develop and implement a vessel-specific DCR discharge management plan to minimize DCR discharges.

With mitigation, environmental impacts would be reduced for each alternative (Table 5-2). An impact is not predicted for any of the alternatives relative to the sediment deposition rate or invasive mussel species in lakes Ontario, Erie, and Superior. With mitigation, impacts to sediment physical structure, the benthic community, and invasive mussel species in lakes Michigan and Huron would be reduced to an insignificant level for the No Action and Baseline Control Measures alternatives and reduced to a less-than-insignificant level for the Performance Requirement to Minimize DCR Discharges alternative. The reduced impact associated with the Performance Requirement to Minimize DCR Discharges alternative is a direct result of the greater reduction in DCR discharge volumes achieved with this alternative.

From an economic perspective, impacts to the dry bulk shipping industry, to industries dependent on bulk dry cargo shipping, and to water-dependent infrastructure, including port facilities and commercial shipping lanes, are not present for either of the action alternatives.

In addition to the environmental and socioeconomic considerations, implementation differences between the action alternatives exist. The Performance Requirement to Minimize DCR Discharges alternative has the benefit of implementation flexibility. It accommodates variations in equipment and operating procedures among vessels and shoreside facilities and encourages vessel owners/operators to use their own experience and innovation to determine the most efficient and effective approach to controlling DCR on their vessel and at shoreside facilities. The baseline alternative, in contrast, is not as flexible insofar as it prescribes "universal" control measures.

5.6 Preferred Alternative

The Coast Guard's preferred alternative is Alternative 2, Performance Requirement to Minimize DCR Discharges, which includes the mitigation described in Section 4.10. This alternative, detailed in Section 2.4.2, requires a vessel owner/operator to maintain a "broom clean" standard on deck and to develop and implement a vessel-specific DCR discharge management plan to minimize DCR discharges. Under this alternative, the DCR discharge would be controlled largely by adhering to DCR operational and maintenance procedures consistent with normal vessel and bulk-dry-cargo-handling activities. The specific procedures and equipment may vary among vessels and facilities because conditions, cargoes, and equipment vary. This alternative would maintain DCR discharge exclusion areas, reduce recordkeeping requirements, and, with mitigation, would eliminate limestone and clean stone DCR discharges in all port and nearshore areas and within 3 statute miles of shoreline except in the dredged navigation channels of the Western Basin of Lake Erie.

The Coast Guard's preferred alternative is Alternative 2 with mitigation because it has no economic impact and has little or no impact on any natural resources.

The Performance Requirement to Minimize DCR Discharges alternative reduces DCR to a greater degree than the Baseline Control Measures alternative. This is because the Performance Requirement to Minimize DCR Discharges alternative requires vessels to develop and implement a vessel-specific DCR discharge management plan to minimize DCR discharges. The Baseline Control Measure alternative does not reduce DCR as much because it requires the vessels and shoreside facilities only to operate and maintain the control measures and does not require them to reduce DCR discharge volumes.

The Performance Requirement to Minimize DCR Discharges alternative has the benefits of the greatest estimated percent reductions and total volume reductions of DCR discharge, greater levels of effectiveness associated with a focus on taking action to reduce DCR discharge and end results, and a reduction in potential environmental impacts in nearshore areas. Like the No Action alternatives and the Baseline Control Measure alternative, the Performance Requirement to Minimize DCR Discharges alternative meets the economic impact criterion of "no impact."

TABLE 5-2
Comparison of Alternatives Based on Significance Criteria

Resource Category	1—No Action		2—Minimize DCR		3—Baseline Control Measures	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Sediment Quality						
Sediment physical structure	●	◍	◍	◌	●	◍
Sediment deposition rate	●	○	●	○	●	○
Biological Resources						
Benthic community	●	◍	◍	◌	●	◍
Invasive mussel species—Lake Ontario, Lake Erie, Lake Superior	●	○	◍	○	●	○
Invasive mussel species—Lake Michigan, Lake Huron	●	◍	◍	◌	●	◍
Socioeconomic Resources						
Economic systems—dry bulk carrier industry	○	○	○	○	○	○
Economic systems—industries dependent on great lakes waterborne dry bulk shipping	○	○	○	○	○	○
Water-dependent infrastructure—commercial shipping lanes	○	○	○	○	○	○
Water-dependent infrastructure—port facilities	○	○	○	○	○	○

○ No adverse impact.

◌ Impact, but less than an insignificant (minor) adverse impact.

◍ Insignificant (minor) adverse impact.

● Significant adverse impact.

insignificant impact for all the areas through the prohibition of nearshore DCR discharge, except for the Western Basin of Lake Erie, where the impact was reduced to insignificant. The impact was reduced in this area as a result of limiting discharges to the dredged channels in the Western Basin of Lake Erie (only by vessels transporting cargo exclusively within the basin), which could not be mitigated without economic impact to industry.

Allowing DCR discharge was considered a significant impact in the Phase I Final EIS because the possibility (but not the probability) existed that at some time—possibly due to an unusual event such as adverse weather or navigation issues—an impact could occur if there were any discharge in a protected or sensitive area. However, in the Phase I Final EIS, other resource impacts were assessed on the basis of probability rather than possibility, and in all cases, upper ranges of DCR discharges were used in predicting impact to provide conservative predictions.

Therefore, for consistency purposes, the criteria for a significant impact in protected and sensitive areas were reconsidered in the context of the *probability* of an impact occurring, rather than the *possibility* of it occurring. The probability of an impact is highly unlikely, given the limited number of vessels in the Western Basin of Lake Erie discharging to these areas and the limitations on areas of discharge to previously disturbed (dredged) navigation channels. As a result, no impact is expected to this area with the mitigation as detailed under the interim rule, and impacts to protected and sensitive areas are not included in the Tiered Final EIS.

Table 4-1 summarizes the resource categories that were evaluated in the Phase I Final EIS and those carried forward for evaluation in the Final Tiered EIS.

TABLE 4-1
Resources Categories to Be Evaluated

Addressed in Phase I Final EIS	With Predicted Impacts in Phase I Final EIS	To Be Evaluated in Tiered EIS
Sediment Quality		
Sediment chemistry	—	—
Physical structure	✓	✓
DCR deposition rate	—	✓
Water Quality		
Water chemistry	—	—
Nutrient enrichment	—	—
Dissolved oxygen	—	—
Biological Resources		
Special status species	—	—
Protected and sensitive areas	✓	—
Benthic community	✓	✓

TABLE 4-1
Resources Categories to Be Evaluated

Addressed in Phase I Final EIS	With Predicted Impacts in Phase I Final EIS	To Be Evaluated in Tiered EIS
Fish and other pelagic/planktonic organisms	—	—
Invasive mussel species—Lake Ontario, Lake Erie, Lake Superior	—	✓
Invasive mussel species—Lake Michigan, Lake Huron	✓	✓
Waterfowl	—	—
Socioeconomic Resources		
Economic systems—dry bulk carrier industry	✓	✓
Economic systems—industries dependent on Great Lakes waterborne dry bulk shipping	✓	✓
Water-dependent infrastructure—commercial shipping lanes	—	—
Water-dependent infrastructure—port facilities	✓	✓
Fishing—recreational and commercial	—	—

4.2 Standards of Significance Criteria

Criteria for evaluating potential impacts to the affected environment and determining the significance of the impacts are outlined by CEQ in the definition of "significantly" (40 CFR 1508.27). The regulations state that significance is determined by the intensity or severity of the impact and the resource area in which it occurs. Intensity criteria are based on the following:

- Degree of change to unique geographic characteristics, such as visual quality, harbors, archaeological sites, wetlands, or ecologically critical areas
- Potential for environmental or scientific controversy
- Degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks
- Potential for establishing a precedent for future actions or representing a decision in principle about a future consideration
- Relation of the impact to other, individually insignificant actions but with cumulatively significant impacts
- Degree to which endangered or threatened species or their habitats may be affected
- Potential for violation of Federal, State, or local environmental standards

Using these criteria, three levels of impact were identified:

- **No Impact.** Implementation of the action or the alternative has negligible or no effect, either adverse or beneficial, on the resource.
- **Insignificant Impact.** Implementation of the action or alternative has an effect, either adverse or beneficial, but the impact does not exceed the established threshold for significance and is generally considered minor.
- **Significant Impact.** Implementation of the action or alternative would cause a major alteration or have a major effect on the resource, either adverse or beneficial.

Impacts may be reduced by implementing appropriate mitigation measures. Mitigation measures can affect operational requirements and economic factors. Therefore these factors must be considered when proposing mitigation measures.

The same impact criteria for a given resource were applied to each of the Great Lakes. For all but invasive species, the criteria were applied to the lakes as a single system. Because there are substantial differences among lakes in factors affecting invasive species, invasive species' criteria were applied to each lake individually. As described in Section 4.7, the differing conditions among lakes resulted in differing levels of invasive species impacts.

The criteria used to determine the level of impact for the resource areas evaluated in the Phase I Final EIS are detailed in Chapter 4 of the Phase I Final EIS. The criteria used to determine the level of impact for the resource areas evaluated in this Tiered Final EIS are summarized in Table 4-2 and detailed in the following sections.

TABLE 4-2
Summary of Significance Criteria for Tiered Final EIS

Resource Category	No Impact	Insignificant Impact	Significant Impact
Sediment Quality			
Physical structure	No alteration of benthic habitat (no change in grain size distribution or other physical characteristics of sediment)	Minor change in grain size distribution or other physical characteristics of sediment, resulting in only slight alteration of benthic habitat	Considerable change in grain size distribution or other physical characteristics of sediment, which would result in substantial alteration of benthic habitat
DCR deposition rate	DCR rate within range of background	DCR and natural rates no more than 10% greater than maximum natural rate	DCR and natural rates over 10% greater than maximum natural rate
Biological Resources			
Benthic community	No alteration of benthic habitat	Slight alteration of benthic habitat, as evidenced by minor changes in grain size or other physical characteristics	Substantial alteration of benthic habitat, as evidenced by major changes in grain size or other physical characteristics

TABLE 4-2
Summary of Significance Criteria for Tiered Final EIS

Resource Category	No Impact	Insignificant Impact	Significant Impact
Invasive mussel species	Factors other than substrate limit mussel distribution, maximum mussel population capacity already achieved, or no discharge of DCR	Additional substrate from DCR would not increase mussel populations to the extent to have measurable, immediate, and ecosystem-level impacts	DCR discharge in areas that lack abundant habitat, thus increasing the carrying capacity for mussel populations
Socioeconomic Resources			
Economic systems—dry bulk carrier industry	DCR management practices do not affect efficiency of shipping; negligible economic costs	DCR management practices minimally affect efficiency of shipping; minor economic costs	DCR management practices substantially affect efficiency of shipping; major economic costs
Economic systems—Industries dependent on Great Lakes waterborne dry bulk shipping	DCR management practices do not affect efficiency of shipping; negligible economic costs	DCR management practices minimally affect efficiency of shipping; minor economic costs	DCR management practices substantially affect efficiency of shipping; major economic costs
Water-dependent infrastructure—port facilities	DCR management practices do not affect efficiency of shipping; negligible economic costs	DCR management practices minimally affect efficiency of shipping; minor economic costs	DCR management practices substantially affect efficiency of shipping; major economic costs

4.2.1 Sediment Physical Structure

The physical structure of the sediments was evaluated in the Phase I Final EIS by assessing the potential for DCR discharges to alter the composition of the sediments, as indicated by grain size, to the degree that the habitat for benthic, or sediment-dwelling organisms, as indicated by benthic samples, would be affected adversely. To evaluate the alternatives considered in this Tiered Final EIS, the criteria for sediment physical structure were revised to allow an assessment based on predicted impacts, rather than on measured sediment grain size distributions and benthic community structure, as was done in the Phase I Final EIS. The criteria were revised because the Phase I Final EIS analysis was based on measured sediment parameters in areas of DCR discharge reflecting a long-term period of discharge; those areas were then compared with reference areas. The Phase I Final EIS analysis compared sediment conditions resulting from existing DCR discharge practices with alternatives to manage DCR discharge relative to reference conditions. In contrast, this Tiered Final EIS is evaluating impacts of the alternatives based on predicted reductions in DCR discharges relative to the No Action alternative. Therefore, the criteria were revised to reflect this change from parameters that could be measured, as was done in the Phase I Final EIS, to criteria that reflect this predictive approach.

The impact criteria for sediment physical structure for the Tiered EIS are as follows:

4.2.1.1 No Impact

If DCR could be discharged but no alteration of the benthic habitat were to occur (no change in grain size distribution or other physical characteristics of the sediment), then no adverse or beneficial impact to sediment physical structure would be expected.

4.2.1.2 Insignificant Impact

If slight alteration of the benthic habitat were to occur (as evidenced by minor alterations of the grain size distribution and other physical characteristics of the sediment), then an insignificant impact to sediment physical structure would be expected.

4.2.1.3 Significant Impact

If substantial alteration of benthic habitat were to occur (as evidenced by considerable alterations of the grain size distribution and other physical characteristics of the sediment), a significant impact to sediment physical structure would be expected.

4.2.2 DCR Deposition Rate

The impact of DCR deposition rate was evaluated to determine whether the rate of DCR deposition could affect sediment quality by smothering benthic organisms or their habitats. Impacts resulting from DCR deposition rates were evaluated using the same criteria as those used in the Phase I Final EIS, which are as follows:

4.2.2.1 No Impact

If the combined rate of natural sediment deposition and predicted DCR deposition were near that of the natural deposition rate alone, then no impact to benthic organisms would be expected.

4.2.2.2 Insignificant Impact

If the combined rate of natural sediment deposition and predicted DCR deposition were no more than 10 percent greater than the maximum natural sediment deposition rate alone (an amount considered to be reasonably small by expert opinion), then an insignificant impact to benthic organisms would be expected.

4.2.2.3 Significant Impact

If the combined rate of natural sediment deposition and predicted DCR deposition were more than 10 percent greater than the maximum natural sediment deposition rate alone, then a significant impact to benthic organisms would be expected.

4.2.3 Benthic Community

Impacts to the benthic community were evaluated in the Phase I Final EIS by comparing the structure and composition of the benthic invertebrate community in areas of high-intensity DCR discharges with those of the benthic invertebrate community in reference areas outside the DCR discharge areas. The comparisons were based on the following parameters:

- Bulk sediment toxicity of sediments from current DCR discharge areas compared with those from reference areas (Appendix N of the Phase I Final EIS).
- Toxicity of DCR discharges compared with toxicity of laboratory control sediments (Appendix S of the Phase I Final EIS).

- Benthic community structure of sediments from current DCR discharge areas compared with those from reference areas (Appendix N of the Phase I Final EIS).
- Chemical tissue residues in benthic organisms in the DCR discharge areas compared with those of organisms from the reference areas (Appendix N of the Phase I Final EIS).

As summarized in Chapter 3 of this Tiered Final EIS and detailed in the Phase I Final EIS, the amphipod *Diporeia* spp. has been used as an indicator of benthic community health. Although the density and relative abundance of this species have declined in recent decades, there is no indication that DCR discharges have been a contributing factor. The abundance of the species in DCR track lines is not lower than in areas where there is no DCR discharge (Phase I Final EIS, Section 3.3.4.3 and Figure 3-12). Also, DCR does not produce any toxic effects on amphipods (Phase I Final EIS, Appendix S). Because there is no indication that past DCR discharge practices have caused any impact on *Diporeia* spp., and because the alternatives in this Tiered Final EIS result in equal or less DCR being discharged, no impacts to these indicator species are anticipated for the alternatives, and *Diporeia* spp. are not evaluated in this chapter.

To evaluate the alternatives considered in this Tiered EIS, the criteria for the benthic community were revised to allow an assessment based on predicted impacts rather than on measured sediment toxicity, chemical tissue residues, and benthic community structure, as was done in the Phase I Final EIS. The criteria were revised because the Phase I Final EIS analysis was based on measured parameters in areas of DCR discharge relative to reference conditions. In contrast, this Tiered EIS is evaluating impacts of the alternatives based on predicted reductions in DCR discharges relative to the No Action and therefore, the criteria were revised to reflect this predictive approach. The impact criteria for the benthic community for the Tiered EIS are as follows:

4.2.3.1 No Impact

If (1) DCR could be discharged without altering the benthic habitat (no change in grain size distribution or other physical characteristics of the sediment) and (2) no direct toxicity to the growth, reproduction, or survival of benthic organisms from DCR at the highest predicted DCR densities on the lake floor were expected, then no adverse or beneficial impact to the benthic community would be expected.

4.2.3.2 Insignificant Impact

If slight alteration of the benthic habitat were to occur (as evidenced by minor alterations of the grain size distribution and other physical characteristics of the sediment), and no direct toxicity on growth, reproduction or survival from DCR at the highest predicted DCR densities on the lake floor were expected, then an insignificant impact to the benthic community would be expected.

4.2.3.3 Significant Impact

If substantial alteration of benthic habitat were to occur (as evidenced by considerable alterations of the grain size distribution and other physical characteristics of the sediment), or if direct toxicity from DCR was expected, a significant impact to the benthic community would be expected.

4.2.4 Invasive Mussels

Invasive mussels, such as the zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena bugensis*), have become a significant problem in the Great Lakes. The potential for DCR to worsen this problem by providing new or enhanced habitat for the species was evaluated. No potential effects on any invasive species except zebra and quagga mussels were identified. Impacts related to invasive mussel species were evaluated using the same criteria presented in the Phase I Final EIS:

4.2.4.1 No Impact

If discharges occurred under the alternative but invasive mussel species did not prefer attaching to DCR (when present at anticipated maximum densities and depths on the lake bottom) to attaching to native soft sediment, then no impact would be expected. Additionally, if mussel distribution were limited by factors other than substrate or if maximum mussel population capacity were already achieved, then no impact would be expected.

4.2.4.2 Insignificant Impact

An alternative was considered to have an insignificant impact if the laboratory studies conducted as part of the Phase I Final EIS showed that these invasive mussel species can attach to DCR when it is present on the lake bottom at anticipated depths and maximum densities, but attachment is less than 10 percent greater than the attachment observed on native soft sediment. The less-than-10-percent threshold was chosen here, as for other resource areas, on the basis of expert opinion and because it is an increase that can be measured. Also, the threshold is intended to represent an increase in mussel density but not an increase that would have measurable, immediate, and ecosystem-level impacts.

4.2.4.3 Significant Impact

A significant impact would be expected for an alternative if laboratory studies that were conducted were to show that these invasive mussel species can attach to DCR and that the proportion that attached to the DCR present at anticipated depth and density was more than 10 percent greater than the level of attachment observed on native soft sediment. This greater-than-10-percent threshold was selected because such an increase could have immediate and ecosystem-level impacts.

4.2.5 Socioeconomic Resources

Socioeconomic resources considered for this Tiered Final EIS include economic systems, consisting of the waterborne dry bulk carrier industry and other industries dependent on Great Lakes waterborne dry bulk shipping, and associated costs; water-dependent infrastructure consisting of port facilities and commercial shipping lanes; and fishing and associated costs. The resources were selected for their possible connection to DCR. Socioeconomic resources that were eliminated from consideration are listed in Sections 3.2.6 and 3.2.8–3.2.10 of the Phase I Final EIS.

The evaluation of impacts to economic systems focused on the effects of each alternative on the waterborne dry bulk carrier industry and other industries directly dependent on Great Lakes waterborne dry bulk shipping (shippers and receivers) and the relative costs to implement and carry out the alternatives.

The criteria to evaluate "insignificant" and "significant" are based upon those used by EPA in the VGP rule (USEPA, 2008; Abt, 2008). To evaluate the potential impact of the alternatives on small entities, EPA used a cost-to-revenue test to evaluate the potential severity of economic impact on vessels and facilities owned by small entities. The test calculates estimated annualized pretax compliance cost as a percentage of total revenues and uses thresholds of 1 percent and 3 percent to identify facilities that would be significantly impacted as a result of the VGP.

The criteria to evaluate "insignificant" and "significant" are different than those used in the Phase I Final EIS because more data on both alternative costs and shipping industry economic data are now available. The criteria are not meant to denote "economic significance" as defined in Executive Order 12866.

4.2.5.1 No Impact

The alternative would not affect the efficiency of waterborne shipping or the industries that depend directly on that shipping. The estimated economic costs to shipping and the industries that depend directly on that shipping would be negligible. For the DCR alternatives, no impact would occur if costs were less than 1 percent of revenues for the U.S. Great Lakes dry bulk carrier fleet.

4.2.5.2 Insignificant Impact

The alternative would have a minor effect on the efficiency of waterborne shipping, or the industries that depend directly on that shipping. The estimated economic costs to shipping and the industries that depend directly on that shipping would be minor. For the DCR alternatives, "insignificant" impact would occur if costs were between 1 and 3 percent of revenues.

4.2.5.3 Significant Impact

The alternative would have a major effect on the efficiency of waterborne shipping, or the industries that depend directly on that shipping. The estimated economic costs to shipping and the industries that depend directly on that shipping would be major. For the DCR alternatives, "significant" impact would occur if costs were greater than 3 percent of revenues. Note that this criterion does not denote "economic significance" as defined in Executive Order 12866.

4.3 Impacts Summary

The CEQ guidance for EISs calls for a summary and categorization of impacts in terms of the following "CEQ impact categories" (Table 4-3). Where impacts are identified for an alternative in this chapter, they are summarized in terms of each of the CEQ impact categories following a discussion of impacts.

Under NEPA, cumulative impacts must also be considered in the assessment of a proposed action's potential impacts. For the purposes of NEPA, the CEQ regulations define a "cumulative impact" as

> … the impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative

impacts can result from individually minor, but collectively significant, actions taking place over a period of time [40 CFR 1508.7].

In considering potential cumulative impacts associated with the alternatives for this Tiered Final EIS, CEQ's (1997) guidance, *Considering Cumulative Effects under the National Environmental Policy Act*, was followed.

TABLE 4-3
CEQ Impact Categories

Category	Definition
Direct impacts	Changes in an environmental resource that are in immediate temporal or spatial proximity to an activity of an alternative.
Indirect impacts	Changes in an environmental resource that result from a direct impact of an alternative. They are one or more steps removed from an immediate temporal or special change in a resource.
Short-term impacts	Changes in an environmental resource that are finite in duration, do not persist for the entire duration of the alternative, and occur generally immediately upon implementation of an alternative.
Long-term impacts	Changes in an environmental resource that persist as long as an alternative. For projects involving construction of a facility, the impacts associated with the actual construction are considered short term and impacts occurring during operation of the constructed facility are considered long term.
Adverse effects that cannot be avoided	Negative changes in an environmental resource that result from implementation of the essence of an alternative and would occur even with mitigation.
Relationship between short-term use of the environment and long-term productivity	Description of relative environmental costs resulting from direct consumption or change in an environmental resource versus the relative environmental cost from loss of environmental productivity over the duration of the change.
Irreversible and irretrievable commitment of resources	Consumption of a resource or change so severe the function of the resource is lost in perpetuity.

Typically, a cumulative-impacts analysis predicts the additive effects of existing similar activities that recur frequently in the affected area, a proposed action not yet implemented, and public and private plans that might occur in the future and affect resources. In contrast, for the DCR evaluation, impacts of discharging of DCR can be measured directly because discharging has occurred for decades. The additive effect of DCR discharges and other discharges having a similar impact to the Great Lakes is most closely characterized by conditions under the interim rule. Similarly, effects from other activities (for example, land-based runoff and discharges) have occurred simultaneously with the discharging of DCR, and the interactions of these activities are measurable and do not require speculation. Therefore, Chapter 3 (Affected Environment) reflects the past cumulative impact of DCR activities, which are very similar to those anticipated under the alternatives and other ongoing or anticipated activities that might cause additional stress.

The predicted impacts to natural resources of concern (i.e., sediment physical structure, benthic community, and invasive mussels) for the Proposed Action in the Phase I Final EIS reflect DCR discharges that have occurred over the last several decades because the

Proposed Action was a continuation of past practices. Alternative 1, No Action, is also the continuation of current and past DCR discharge practices; thus impacts for this alternative are generally the same as described in the Phase I Final EIS for the Proposed Action. The prediction of impacts of the action alternatives (Alternatives 2 and 3) reflect the predicted reduction of DCR achieved by the DCR control approach embodied in each alternative. The predicted DCR volumes for each alternative were presented as part of the description of alternatives (Section 2.4) and summarized below (Table 4-4). In large part, the impacts on the natural resources of concern for these alternatives will be reduced in proportion to the estimated reduction in DCR discharge achieved by the alternative.

The DCR discharge reductions predicted for the purpose of impact evaluation are summarized below (Table 4-4) and described in detail in Appendix G. Both observations of DCR management practices and review of vessel record forms were used to formulate the predicted DCR discharge volumes for loading and unloading events. However, estimates for unloading events are based primarily on the observations because, as described in Appendix D, the vessel records are highly variable and unreliable for unloading events. The predictions for DCR discharges associated with unloading events are based on observed events that most closely represented the conditions consistent with the description of the alternative. Although the observations were also used for the predictions of DCR resulting from loading events, the DCR discharge predictions associated with loading events were based primarily on the vessel records. The vessel records were the primary source because they constitute a much larger sample and, for loading events, they were generally validated by the observations.

The predicted DCR volumes and associated discharges for both unloading and loading events include a safety factor to conservatively estimate DCR volumes and the impacts resulting from the DCR discharge, thus avoiding underprediction of impacts. Where actual conditions reflective of those imposed by an alternative were not observed for any unloading event, engineering judgment was required to estimate the volume of DCR that would result and be discharged if all of the conditions specified in the alternative were achieved. Consistent with the conservative approach of estimating discharge volumes, in these cases the predictions reflect only half the DCR discharge reduction estimated using engineering judgment. Similarly, for loading events, the predicted DCR discharge volumes reflect control of only those loading events resulting in the largest volumes of DCR discharge and no reductions of the lower volume discharge events were included in the estimate.

The alternatives are predicted to substantially reduce DCR discharge:

- *Alternative 2 by 54–85%*
- *Alternative 3 by 17–62%*

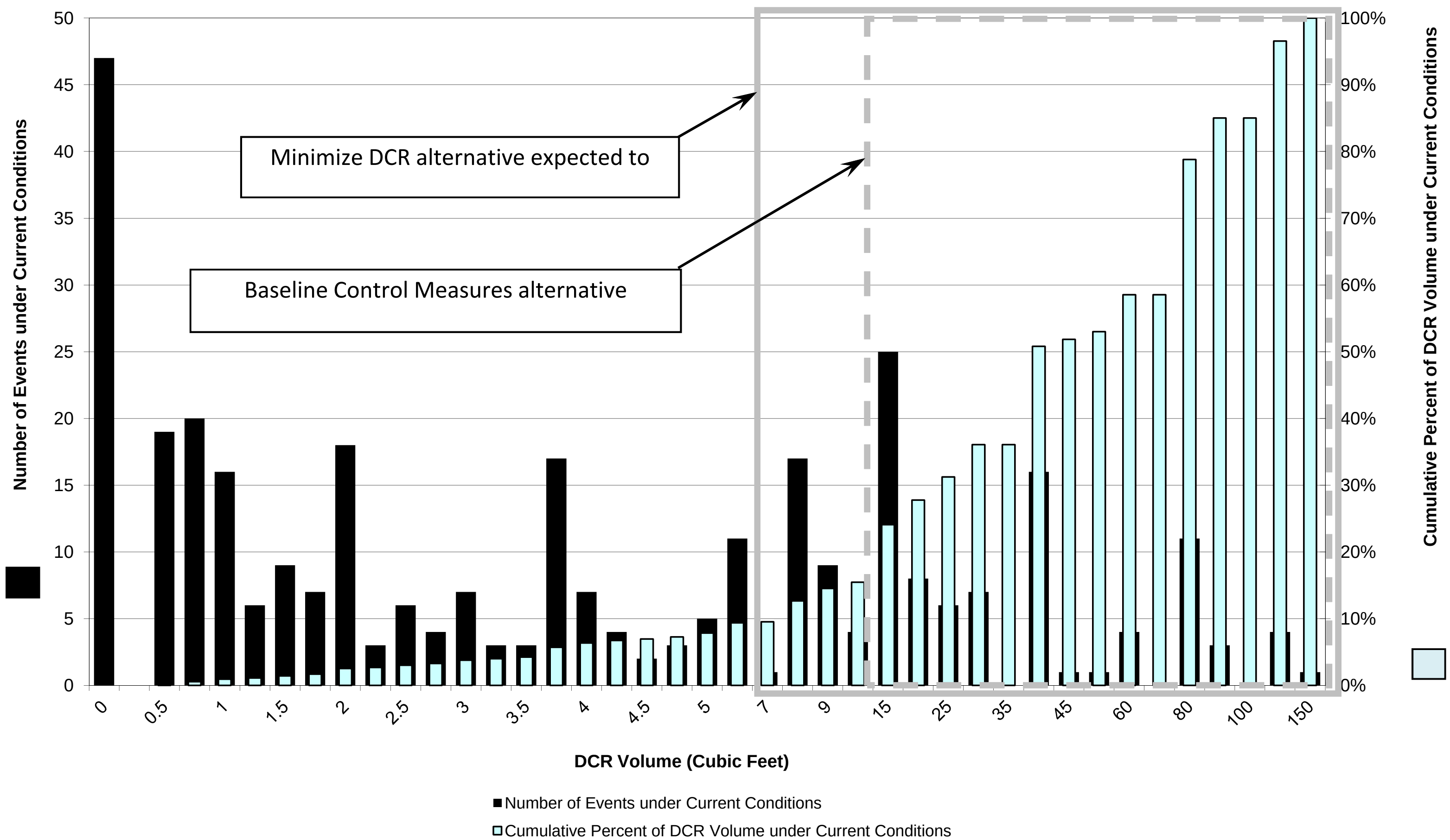
TABLE 4-4
Predicted Reduction in DCR Discharge Volume per Discharge Event for Each Alternative

	No Action		Minimize DCR Discharges			Baseline Control Measures		
	Median	Mean	Median	Mean	Estimated DCR Volume Reduction Compared to No Action Alternative (%)	Median	Mean	Estimated DCR Volume Reduction Compared to No Action Alternative (%)
Loading[a]								
Coal (ft^3)	3.4	11.6	3.4	3.6	69	3.7	5.1	56
Limestone (ft^3)	3.7	18.8	3.7	4.9	74	3.7	7.1	62
Taconite (ft^3)	3.0	19.3	3.0	4.5	77	3.0	8.3	57
Unloading[b]								
Coal (ft^3)	41.1	48.9	6.3	6.3	85	34.0	32.0	17
Limestone (ft^3)	25.1	241.2	4.7	4.7	81	15.0	15.0	40
Taconite (ft^3)	9.3	9.3	4.3	3.9	54	4.7	4.7	49

[a]Reductions calculated with the means because of large data set.
[b]Reductions calculated with the medians because of small data set.

2600

FIGURE 4-1
Distribution of Coal DCR Discharges 2008–2009 Loading Events
Based on 2008–2009 vessel records.



2601

As indicated in Figure 4-1 (example presented for coal; other DCR types have a similar distribution, as described in Appendix G), the predicted DCR volumes for coal loading under the two action alternatives would substantially reduce the relatively few numbers of, but cumulatively large volumes of, DCR discharges. Note that these predictions are for the entire fleet; no reduction in current DCR discharge volumes will occur for the many vessels that currently implement best DCR management practices. The predicted reductions would occur from the relatively few vessels that currently produce the majority of the DCR discharge implementing practices used on most other vessels. The same pattern holds for loading events for all cargoes (Appendix G) and is expected for unloading events also.

These conservative factors were applied to the predictions to account for uncertainty, effects of weather or other complicating factors, accidents, equipment failures and lack of full and consistent compliance with the requirement of the alternative. Full and consistent adherence to the conditions imposed by the alternative could result in substantially lower volumes of DCR discharge than those predicted for the impact evaluation.

The following sections describe the environmental consequences to resources identified in the Phase I Final EIS that would be affected by alternatives discussed in Chapter 2.

4.4 Sediment Physical Structure

Substantial change in the characteristics of the sediments, such as introduction of significant volumes of large particles, can alter the composition of the benthic community. This in turn can alter the benthic ecosystem functions, such as food supply for fish and nutrient processing. Thus the evaluation of sediment physical structure resulting from DCR discharges focuses on how the discharge could alter the benthic habitat.

Without mitigation, impacts on sediment physical structure are:

- *Significant for Alternatives 1 & 3*
- *Insignificant for Alternative 2*

Past, present, and reasonably foreseeable future conditions affecting sediment physical structure are based on trends in land use, development, land and water management, and regulatory conditions. Sediment from land use and development activities in the watershed will continue, but based on Federal and State regulations, there will be an ongoing emphasis on reducing nonpoint sources of pollution. There is expected to be a continued emphasis on managing peak stormwater flows and low-impact development patterns that reduce stormwater runoff, associated pollutants, and degradation and erosion of stream channels, and thereby reduce sediment contributions to the Great Lakes.

4.4.1 Alternative 1: No Action

The Phase I Final EIS found that continued DCR practices would produce insignificant direct, long-term, and cumulative impacts to sediment physical structure. This prediction was a result of observed minor coarsening and de-enrichment in the physical structure of the sediment, particularly in concentrated areas of historic DCR deposition (Phase I Final EIS Appendices H and I). This impact prediction is also applicable to the No Action alternative in this EIS in the open areas of the lakes where DCR is discharged while the vessels are underway.

However, observations conducted for this EIS revealed that under the current interim rule (and thus the No Action alternative) discharge of limestone and clean stone DCR can occur while vessels are stationary at loading or unloading docks. This is because the interim rule does not prohibit the discharge of limestone and clean stone DCR within 3 statute miles of shore, as is the case for other cargo types. Multiple discharges of stone at port and nearshore areas could create as much as an inch (2.5 cm) per year of DCR on the lake floor (Appendix I), which could completely alter the existing sediment physical structure and potentially affect the benthic habitat. Thus in the port and nearshore areas this alternative could have a significant direct, long-term, short-term, and cumulative impact to sediment physical structure.

4.4.2 Alternative 2: Performance Requirement to Minimize DCR

Similar to the No Action alternative, the Minimize DCR alternative would contribute DCR particles (which are different in size and density to native material on the lake floor) to the natural soft sediments in the open waters of the Great Lakes. This could alter the grain size distribution and potentially affect benthic habitat. The open lake deposition would be even less than for the No Action alternative (54 to 85 percent reduction, depending on cargo type and loading versus unloading; Table 4-4) and the alternative is predicted to reduce the frequency of large discharges, which create concentrated areas of DCR in the sediment. Thus the impact would be less for this alternative than for No Action, but because DCR would still slightly alter the grain size and other physical characteristics of the sediment, at least in specific areas of discharges, there would still be some potential impact. Thus for the open areas of the lakes this alternative would produce direct, long-term, and cumulative impacts to sediment physical structure between the no impact and the insignificant impact level.

In ports and nearshore areas, this alternative would have impacts similar to those described above for No Action, but considerably less because even though limestone and clean stone discharges would be allowed in these areas, there would still be the requirement to minimize the discharge. Thus the discharge and subsequent deposition of stone in ports and nearshore areas is estimated to be substantially less than that for No Action (Table 4-4) and the impacts would similarly be less. In port and nearshore areas this alternative would have an insignificant direct, long-term and cumulative impact to sediment physical structure.

4.4.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures

The volume of DCR discharge for this alternative is predicted to be between the volumes predicted for No Action and Minimize DCR (Table 4-4). Thus, the impacts on sediment physical structure in the open waters would be between the impacts for these two alternatives. However, at reduction of only 17 to 62 percent (Table 4-4), the impacts are still considered an insignificant direct, long-term, and cumulative impact to sediment physical structure in the open waters of the lakes.

The Baseline Control Measures alternative does not require limiting the overall volume of discharge and allows discharge of limestone and clean stone while the vessel is in port or a nearshore area. Thus the discharge of limestone and clean stone in port or nearshore areas could be the same as that for the No Action alternative and the impacts would be the same (significant direct, long-term, short-term and cumulative impacts to sediment physical structure).

4.5 DCR Deposition Rate

The impact of DCR deposition rate was evaluated to determine whether the rate of DCR deposition could affect sediment quality by smothering benthic organisms or their habitats. The Phase I Final EIS predicted no impact from DCR depositional rates but the analysis was focused on the shipping lanes in the open lakes. As discussed above, the observations of bulk dry cargo handling procedures conducted for this EIS revealed at least some vessels discharge limestone DCR while in port or a nearshore area, which is not prohibited under the interim rule. Thus the impact on DCR deposition rate that could result from this practice was evaluated (Appendix I).

Without mitigation, impacts on sediment deposition rates are significant for all alternatives.

As described in the Phase I Final EIS, there would be no long-term, short-term, direct, indirect, or cumulative impacts to deposition rates from DCR from any alternative in the open waters because the combined natural and DCR annual deposition rates are in the range of natural deposition rates. DCR deposition rates in the open lake were found to be 0.2 percent or less of the natural deposition rate even in the areas of highest DCR discharge activity (Phase I Final EIS, Appendix N). However, as discussed below, in port and nearshore areas, discharge of limestone and clean stone DCR could create significant long-term, short-term, direct, indirect, and cumulative impacts because the combined natural and DCR annual deposition rates are more than triple natural deposition rates.

4.5.1 Alternative 1: No Action

In the open waters of the lake, there would be no impact on sediment deposition rates from the No Action alternative because as described in the Phase I Final EIS continued DCR practices would be within the range of natural deposition rates.

In contrast, DCR discharges of limestone and clean stone in port or nearshore waters could result in DCR buildup of up to an inch (2.5 cm) per year (Appendix I). This is almost four times the maximum sedimentation rates for the lakes reported in the literature (0.25 inch or 0.6 cm per year as summarized in Chapter 3, Phase I Final EIS). This constitutes a significant long-term, short-term, direct, indirect, and cumulative impact to sediment deposition rate.

4.5.2 Alternative 2: Performance Requirement to Minimize DCR

The Minimize DCR alternative would result in less deposition than the No Action alternative. As described in detail in Appendix G and based on observations of dry cargo–handling procedures, when the conditions of this alternative are adhered to, the DCR discharge rates would be approximately 54 percent to 85 percent less under the Minimize DCR alternative (Table 4-4). Since the No Action alternative has no impact in the open waters, this would also be the case for the Minimize DCR alternative.

In port and nearshore areas, vessels could continue to discharge limestone and clean stone under this alternative. However, they would be required to minimize DCR discharge, which would include discharges in port and nearshore areas, and those discharges would be substantially reduced. This is particularly true for the large discharge events because concentrated large-volume areas of DCR are the most easily collected before they are discharged. Although reduction of limestone and clean stone discharges in port and nearshore areas will likely be greater than the anticipated 70 percent to 80 percent for this alternative (Table 4 -4), the discharges could be as high as 0.6 cm/year (0.25 inch/year) which is equivalent to maximum background deposition rates (70 percent reduction of rates for the No Action alternative). This volume of DCR discharged in port and nearshore areas would constitute a significant long-term, short-term, direct, indirect, and cumulative impact to sediment deposition rate.

4.5.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures

This alternative would result in DCR discharges smaller than the No Action alternative (Table 4-4). Since the No Action alternative would not impact sediment deposition rate in the open waters of the lakes, none are anticipated from the Baseline Control Measure alternative.

In ports and nearshore areas, this alternative would produce somewhat less limestone and clean stone DCR than the No Action alternative (about 40 to 60 percent reduced volume, as summarized in Table 4-4 and detailed in Appendix G). However when this volume is discharged it would still be approximately twice the maximum natural deposition rate and thus result in a significant long-term, short-term, direct, indirect, and cumulative impact to sediment deposition rate. The limestone and clean stone discharge from the Baseline Control Measures alternative would be approximately twice that of the Minimize DCR alternative; thus the impact on deposition rate in ports and nearshore areas is anticipated to be comparably greater for the Baseline Control Measures alternative.

4.6 Benthic Community

DCR discharges can affect the benthic community by altering the physical habitat and introducing potential toxic constituents. Thus the impacts of the alternatives were evaluated based on degree of physical alteration and response to the chemical composition of the DCR (Phase I Final EIS, Chapter 4).

Without mitigation, impacts on the benthic community are:

- *Significant for Alternatives 1 & 3*
- *Insignificant for Alternative 2*

4.6.1 Alternative 1: No Action

The evaluation of current conditions in the open waters of the lakes, which reflect DCR practices anticipated under the No Action alternative, concluded there would be long-term, short-term, indirect, and cumulative insignificant impacts to the benthic community. The impact is indirect because it results from the direct impact on sediment physical structure caused by the addition of DCR to the sediment. The evaluation conducted for this Tiered Final EIS did not reveal any conditions that would warrant a different impact prediction for the No Action alternative in the open waters of the lakes.

In ports and nearshore areas the unrestrained discharge of limestone and clean stone DCR would significantly alter the physical structure of the habitat and the natural deposition rate. Also, although DCR did not produce toxic effects when mixed with natural sediments in proportions anticipated for the open lake, limestone DCR alone did result in mortality of benthic organisms (Appendix J). Thus at the high potential rates, limestone and clean stone discharge in ports and nearshore areas is expected to result in significant long-term, short-term, indirect, and cumulative impacts to the benthic community.

4.6.2 Alternative 2: Performance Requirement to Minimize DCR

The predicted impact for the No Action alternative on the open water benthic community is insignificant. The reduced DCR volume with the Minimize DCR alternative would substantially reduce this impact, but not to the level of no impact. Thus, in the open waters, the Minimize DCR alternative would result in an impact between insignificant and no impact.

In port and nearshore areas the discharge of limestone and clean stone DCR would change the physical structure of the sediment and deposition rate and there would be some impact on the benthic community. However, the anticipated DCR discharge of limestone and clean stone is about 70 to 80 percent less than the No Action alternative (as summarized in Table 4-4 and detailed in Appendix G), and much of the reduction would be from elimination or reduction DCR discharge from the largest discharge events. Thus the impact is anticipated to be less for the Minimize DCR alternative and considered to be an insignificant long term, short-term, indirect, and cumulative impacts to the benthic community.

4.6.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures

The reduction in DCR discharge from the Baseline Control Measures alternative (17 percent to 62 percent, as summarized in Table 4-4 and detailed in Appendix G) compared to the No Action alternative is not considered sufficient to eliminate the open lake insignificant impacts predicted for the No Action alternative. Thus the prediction for the Baseline Control Measures in the open waters of the lakes is an insignificant long-term, indirect, and cumulative impact to the benthic community.

In port and nearshore areas, the Baseline Control Measures alternative would result in less limestone and clean stone DCR discharge than the No Action alternative. However, the reduction is less than for the Minimize DCR alternative (about one-half as much reduction for unloading events), and the large-discharge events, which have the potential to create the greatest impact, are expected to continue under the Baseline Control Measures alternative. Thus this alternative is anticipated to have a significant long-term, short-term, indirect, and cumulative impact to the benthic community.

4.7 Invasive Mussels

4.7.1 Alternative 1: No Action

For the No Action alternative, which is the same as the Phase I Final EIS Proposed Action alternative and the interim rule, in the open waters of the lakes there would be insignificant adverse long-term, direct, and cumulative impacts in Lakes Huron and Michigan for invasive mussel species. The impacts are indirect because they result from the direct impact on the physical structure of the sediment resulting from the addition of DCR. Laboratory studies (see Appendix K; this is an expanded version of the invasive mussels studies in Appendices Q and W of the Phase I Final EIS) have shown that these invasive mussel species can attach to DCR when it is present on the lake bottom at anticipated depths and maximum densities, but attachment is less than 10 percent greater than the attachment observed on native soft sediment. Thus an insignificant rather than significant impact is predicted.

Without mitigation, impacts on the invasive mussels are:

- *Significant for Alternatives 1 & 3*
- *Insignificant for Alternative 2*

No impact was predicted for the open waters of the other lakes for the Phase I Final EIS Proposed Action alternative and the same is true here for the No Action alternative. No impact was anticipated in Lake Erie and Lake Ontario because the mussel populations are already approaching maximum density in these lakes. In Lake Superior, factors other than substrate, which is the habitat attribute potentially affected by DCR (primarily calcium concentrations), limit mussel density and distribution. Thus discharge of DCR is not anticipated to affect the invasive mussel populations in the open waters of these lakes.

In port and nearshore areas, large limestone and clean stone discharges could create optimum invasive mussel habitat. In these shallow waters which the mussels prefer, creating bottom substrate that is stone, rather than the native soft sediment creates optimum habitat for these mussels. Even in the lakes that are near maximum mussel densities, addition of the volume of limestone and clean stone DCR that could occur (up to an inch per year) would create additional habitat suitable for mussels. In the other lakes, the addition of high limestone volumes in isolated near shore areas could potentially overcome other limiting factors and invasive mussels could become established. Thus, in port and nearshore areas, a significant long-term, indirect, and cumulative impact is predicted for all lakes.

4.7.2 Alternative 2: Performance Requirement to Minimize DCR

In the open waters of lakes where mussels are already approaching maximum density (Erie and Ontario) or where factors other than substrate limit mussel density and distribution (Superior), the impacts from the Minimize DCR alternative would be the same as for the No Action alternative. Thus in these lakes there is no impact. In the open waters of the other lakes (Michigan and Ontario) the impact on invasive mussels is less than predicted for the No Action alternative because limestone DCR discharge is estimated to be reduced 54 percent to 85 percent compared to No Action. However there still could be an impact in these lakes in the areas of highest density DCR discharge and the impact is considered between no impact and an insignificant impact.

In port and nearshore areas of all the lakes, where limestone and clean stone discharges can occur, a substantial reduction in limestone DCR is predicted from this alternative (a reduction of about 70 percent to 80 percent compared to No Action). This reduction is anticipated to produce less severe impact in port and nearshore areas than the No Action alternative and the impact is considered to be insignificant direct, long-term, and cumulative.

4.7.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures

The reduction of DCR discharge predicted for the Baseline Control Measures alternative is not considered sufficient to eliminate the insignificant direct, long-term, and cumulative impact predicted for the No Action alternative in the open waters of lakes with potential for increased mussel density and distribution (i.e., Michigan and Huron) thus there is an insignificant impact predicted. No impact was predicted for the open waters of the other lakes for the No Action alternative and no impact is anticipated for the Baseline Control Measures alternative since it will result in less DCR discharge.

In the port and nearshore areas of all lakes, reduction of DCR discharge predicted for the Baseline Control Measures alternative is not considered sufficient to eliminate the predicted impact for the No Action alternative. Thus for this alternative the impact from discharge of limestone and clean stone DCR in port and nearshore areas is considered to be significant direct, long-term, and cumulative.

4.8 Cumulative Impacts on Natural Resources

The types of potential future cumulative impacts for all alternatives are anticipated to be very similar to those measured for existing conditions because the same type of activities are anticipated in the future (both for DCR and other factors affecting sediment). However, the intensity of the cumulative impacts is estimated to be less because other factors contributing to alteration of the natural resources of concern, such as water quality degradations, sediment contributions to the Great Lakes, and point and nonpoint discharges will be reduced, as discussed in Section 4.3. Thus the cumulative impacts are considered to be the same or less as those predicted above to result from the DCR alternative alone.

4.9 Socioeconomic Resources

Socioeconomic resources considered for this Tiered Final EIS include economic systems consisting of the waterborne dry bulk carrier industry and other industries dependent on Great Lakes waterborne dry bulk shipping and associated costs; and water-dependent infrastructure consisting of port facilities.

Commercial shipping lanes and fishing and associated costs were evaluated in the Phase I Final EIS, and no impact on these resources were anticipated. Information developed since the Phase I Final EIS was considered, and nothing indicated a change in the conclusion of no impact reached in the Phase I Final EIS. Consequently, we have not considered these categories in this Tiered Final EIS.

None of the alternatives has an economic impact on the Great Lakes shipping industry.

The evaluation of impacts to economic systems focused on the effects of each alternative on the waterborne dry bulk carrier industry and other industries directly dependent on Great Lakes waterborne dry bulk shipping (vessels and shoreside facilities), and the relative costs to implement and carry out control measures. These impacts are summarized below and in Appendix E.

The direct costs to the industry for each alternative were based on estimated costs of alternatives as summarized in Chapter 2 and described in detail in Appendix E, which used Phase I Final EIS alternatives cost estimates (Appendix E in the Phase I Final EIS) using traditional cost-estimating techniques (summarized in Table 2-1 of Appendix E). These were refined based on further information obtained from the direct observations, communication with Lake Carrier Association member companies, research and engineering judgment, and through direct contact with manufacturers of control measures. For example, the observations allowed for more accurate estimates on how long it takes to collect DCR on the deck and also assessment of time to maintain DCR control equipment. In addition, a range of costs was estimated based on two variables: (1) the magnitude of DCR (more labor time for larger volumes and less time for smaller volumes) and (2) the number of trips and vessels, with the Phase I Final EIS values representing the higher end of the range and the 2008–2009 vessel records during the decreased demand in commodities representing the lower end of the range. Costs (in 2009 U.S. dollars) include capital, installation, operation and maintenance, and delay costs to vessels having to remain in port. Although the vessel owner/operators would expend all the capital costs in the first year of the rule, for the purpose of evaluating economic impacts, the capital costs were amortized over the life of the capital improvements using straight line projections. This permitted combining the capital costs, installation, operation and maintenance, and delay costs and expressing them as undiscounted annualized costs. This allowed comparing the combined cost of the alternatives to the undiscounted annualized revenue for the industry.

Estimates were made for loading- and unloading-related control measures separately to recognize the differences in managing DCR from different sources. Loading generates DCR on the deck, while unloading generates DCR in the tunnel and on the deck. Each alternative includes several assumptions that describe the operational procedures and equipment that could be used to achieve the objectives of the alternative. These assumptions took into account those used in the Phase I Final EIS and observed during the observation program (Appendix E). They are used to bound and define the details of the cost estimates of each alternative.

Costs were estimated for U.S. vessels and ports and Canadian vessels and summed to represent the entire Great Lakes fleet (not individual companies, vessels, or ports). Foreign, non-Canadian vessels were not included in the cost estimate because they ship only a small portion of the total bulk dry cargo shipped on the Great Lakes (historically less than 0.5 percent as determined by 2006 shipment tonnages on the Great Lakes (USACE, 2006)).

4.9.1 Alternative 1: No Action

The No Action alternative is a continuation of the interim rule. DCR management practices would remain the same as the current practices with recordkeeping requirements; no incremental costs, beyond what are currently expended, are anticipated. Thus, future conditions and impacts would be the same as those of existing DCR operations.

In the Phase I Final EIS, based on the historic average number of vessels and trips as of 2007, this alternative was found to have no impacts on the waterborne dry bulk carrier industry and other industries directly dependent on Great Lakes waterborne dry bulk shipping because the estimated economic costs would be negligible, consisting of recordkeeping by the shipping companies.

The No Action would be a continuation of existing conditions. The cumulative effect of the No Action combined with foreseeable future actions affecting the operating costs and competitive factors for the waterborne dry bulk carrier industry and related industries is expected to be similar to, or perhaps slightly more intense than, the existing conditions, due to higher operating costs (primarily fuel) for vessels, decreased efficiencies from light loading due to shallow channel depths from lower lake levels and dredging practices, and possibly greater competition from other modes of transportation such as rail and trucking.

4.9.2 Alternative 2: Performance Requirement to Minimize DCR

This alternative would require that the amount of DCR discharged overboard be minimized. This would be accomplished through maintaining a "broom-clean" standard for the deck and would require each vessel owner/operator to develop and implement a management plan that minimizes DCR discharge from the deck and tunnel. There are no specific requirements for equipment or procedures as part of this alternative as it allows the vessel owners or operators to determine the most effective and efficient way to minimize DCR on their specific vessels. Quarterly reporting to the Coast Guard would no longer be required, resulting in a small cost savings. Minimal reporting costs would continue under this alternative, as vessels would still need to maintain DCR discharge records.

The costs to the industry of complying with this alternative were estimated and appear in Appendix E.

Costs were estimated for a high (representing historical number of vessels and trips, and the high end of observed DCR volume) and low (representing historical number of vessels and low end of observed DCR volume) range to account for uncertainty. It is expected the costs for an alternative would most likely fall within that range.

In 2008, approximately 70 percent of the U.S. Great Lakes shipping companies generated over $470 million in revenues. This information is based upon annual 10K reports for the publicly traded companies and Dun and Bradstreet Business Reports for the nonpublic companies.

One percent of these revenues is $4.7 million, and 3 percent is $14.2 million. Using the significance criteria described in Section 4.2 indicates that the range of costs to the U.S. fleet presented in Appendix E for this alternative falls into the "no impact" category. Annual revenues can change by up to 25 percent, as reflected in the collected financial data cited in this Tiered Final EIS. However, even with these revenue changes the impact to the U.S. fleet would still be in the "no impact" category.

The cumulative effect of the Minimize DCR alternative combined with foreseeable future actions affecting the cost and competitive factors for the waterborne dry bulk carrier industry and related industries is expected to be similar to, or perhaps slightly more intense than, the existing conditions, due to higher operating costs (primarily fuel) for vessels, decreased efficiencies from light loading if the current trend of lower lake levels continues, and possibly greater competition from other modes of transportation such as rail and trucking.

4.9.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures

This alternative assumes all vessels and shoreside facilities have all baseline control measures, which were determined from the direct observation program to be available for all vessels (Appendix E in the Phase I Final EIS), or equivalent methods of DCR control, and that all baseline control measure equipment and procedures are functioning as designed. It requires that vessels and facilities keep the control measures they currently have (or equivalent) and provide maintenance to allow the control measures (structural and operational) to function as they were designed and intended. As with the Minimize DCR alternative, this alternative would not delay a vessel in port; would require less intensive recordkeeping, resulting in a cost savings; and would maintain exclusion areas required in the interim rule.

Using the high and low ranges of cost assumptions described above for Alternative 2 and using the significance criteria described in Section 4.2 indicates the range of costs to the U.S. fleet for this alternative falls into the “no impact” category. As previously noted, annual revenues can change by up to 25 percent, as indicated by the range in financial data collected for this EIS. However, even with these revenue changes, the impact to the U.S. fleet would still be in the “no impact” range.

The cumulative effect of the Baseline Control Measures alternative combined with foreseeable future actions emphasizing the cost and competitive factors for the waterborne dry bulk carrier industry and related industries is expected to be similar to, or perhaps slightly more intense than, the existing conditions, due to higher operating costs (primarily fuel) for vessels, decreased efficiencies from light loading in response to the continued current trend of lower lake levels, and possibly greater competition from other transportation modes.

4.10 Impact Mitigation

The impact prediction in the preceding sections for the natural resource areas are differentiated by port and nearshore areas and open water areas, and all the predicted significant impacts are the result of limestone and clean stone DCR discharges in port and nearshore areas. Similarly, almost half of all the insignificant impacts are caused by discharges in port and nearshore areas. Discharges of most DCR types were prohibited in areas within 3 statute miles from shore in the original IEP because of the sensitive habitat in these areas. Limestone and clean stone were not included in this prohibition because these cargoes were considered chemically benign (Ried and Meadows, 1999). Evaluations conducted for the Phase I Final EIS and this EIS identified impacts from physical alteration of habitat caused by concentrated accumulation of limestone and clean stone DCR. This concentrated accumulation is most acute when a vessel discharges DCR while stationary in a port or nearshore area, which was noted during the observation program for this EIS.

Prohibiting limestone and clean stone DCR discharge within 3 statute miles of shore would substantially mitigate the impacts on sediment physical structure, deposition rate, benthic community, and invasive mussels. It would result in no impact for most resources and reduce impacts from significant to insignificant in others (as described above where impacts in port and nearshore areas and in open water are identified separately and as summarized in Table 4-5).

With mitigation, impacts are:

- *Insignificant or less for Alternatives 1 & 3*
- *Between insignificant and having no impact or less for Alternative 2*

Except in the Western Basin of Lake Erie, there are no known lake carrier track lines for limestone or clean stone that do not extend beyond 3 statute miles. Thus vessels could delay discharging limestone and clean stone DCR until they are beyond 3 statute miles and not incur any delays or additional costs. In the Western Basin of Lake Erie, vessels carrying limestone or clean stone might not travel beyond 3 statute miles from shore. However, as required for other cargo types if they restrict DCR discharges to the dredged navigation channels they would not incur any additional costs and limestone or clean stone discharges in a dredged channel would not create adverse impacts to native sediment or benthos.

Thus the mitigation would be no discharge of limestone or clean stone within 3 statute miles of shore, except in the Western Basin of Lake Erie for vessels that do not transit beyond 3 statute miles from shore between loading and unloading. Limestone and clean stone discharges for such vessels would be restricted to the dredged navigation channels.

TABLE 4-5
Summary of Impacts for Resource Areas Affected by Mitigation

	Alternative					
	1: No Action		2: Minimize DCR Discharges		3: Baseline Control Measures	
Impact Area	No Mitigation	With Mitigation	No Mitigation	With Mitigation	No Mitigation	With Mitigation
Sediment physical structure	Significant	Insignificant	Insignificant	Between insignificant and no impact	Significant	Insignificant
Sediment deposition rate	Significant	No impact	Significant	No impact	Significant	No impact
Benthic community	Significant	Insignificant	Insignificant	Between insignificant and no impact	Significant	Insignificant
Invasive mussels—Lakes Erie, Ontario, and Superior	Significant	No impact	Insignificant	No impact	Significant	No impact
Invasive mussels—Lakes Michigan and Huron	Significant	Insignificant	Insignificant	Between insignificant and no impact	Significant	Insignificant

No significant impacts were predicted for economic resources and no mitigation was identified for the insignificant economic impacts.

4.11 Permits, Licenses, and Approvals

This section discusses potential permitting requirements and approvals associated with each of the alternatives under consideration. It is not anticipated that the Coast Guard would require permits for alternatives that would allow the continued discharging of DCR. Currently, the Coast Guard is not aware of any Great Lakes state permitting requirements for DCR.

4.11.1 Alternative 1: No Action

Under the continuation of the interim rule (i.e., No Action), recordkeeping of all DCR discharge activities would be required. Although a permit would not be necessary, Coast Guard review of monitoring records would be necessary. No permits are anticipated.

4.11.2 Alternative 2: Performance Requirement to Minimize DCR

Permits may or may not be required under this alternative, depending on the type of control measures that are implemented at a port facility. If the measures are operational, it is unlikely permits would be required. Structural changes or modifications that affect impervious area and stormwater runoff would likely require local construction permits and stormwater management permit modifications. Recordkeeping of all DCR discharge activities would be required and would need to be available for Coast Guard review. Additionally, a DCR Management Plan would be necessary to outline the management practices being used to minimize the amount of DCR going into the waters of the Great Lakes. No minimization activities that are anticipated on vessels are expected to require a permit.

4.11.3 Alternative 3: Prescriptive Requirement for Baseline Control Measures

Since baseline control measures are already in place, this alternative is not expected to require permits or approvals beyond recordkeeping of all DCR discharge activities.

CHAPTER 6

List of Preparers

This EIS was prepared under the direction of the U.S. Coast Guard and the U.S. Environmental Protection Agency. The individual below assisted by providing agency guidance and resolving questions.

U.S. Coast Guard

Greg Kirkbride, Environmental Analyst and Project Manager
M.S. Environmental Science and Policy
M.B.A
B.S. Economics

The contractor responsible for preparing this document was CH2M HILL. The individuals below contributed to the preparation of this document.

Raquel Blue, Associate Project Manager
B.S. Civil Engineering
Years of Experience: 15

Brent A. Brown, P.E.
M.S. Environmental Engineering
B.S. Civil Engineering
Years of Experience: 11

John R. Burgess, Project Manager
M.S. Zoology
B.A. Biology
Years of Experience: 13

Christine Ehlers, Graphic Designer
B.S. Graphic Communication
Years of Experience: 10

Taylor Fleet, Copyeditor
B.S. English Education
B.A. English
Years of Experience: 17

Jessica Frank
B.S. Civil Engineering
Years of Experience: 8

Trevor W. Ghylin
M.S. Civil and Environmental Engineering
B.S. Civil Engineering
Years of Experience: 4

Justin Hansen, Senior GIS Specialist
B.S. Geography/Earth Science
Years of Experience: 8

Larry Hilscher, Project Scientist
M.S. Statistics
M.S. Chemistry
B.S. Plant and Soil Science
Years of Experience: 29

Ryan Holzem
M.S. Environmental Engineering
B.S. Civil Engineering
Years of Experience: 4

Mary Jo Kealy
Ph.D. Economics
M.S. Economics
B.S. Economics
Years of Experience: 31

A. Ryan Loveridge
M.S. Biology
B.S. Biology
Years of Experience: 12

Brian Loux, Staff Engineer
M.Eng. Environmental Engineering
B.S. Environmental Sciences and Engineering
Years of Experience: 5

Jamie Maughan, Technical Director
Ph.D. Oceanography
M.S. Limnology/Water Resources
B.S. Biology/Ecology
Years of Experience: 36

Kate Mayrides
B.S. Environmental Studies
Years of Experience: 8

Mark Mittag, P.E.
M.S. Civil Engineering
B.S. Civil Engineering
Years of Experience: 16

Lindsay Olinde
M.S. Environmental Engineering
B.S. Civil Engineering
Years of Experience: 4

Mark Rockel, Senior Economist
Ph.D. Marine Studies
M.A. Economics
B.A. Economics
Years of Experience: 31

Valerie Ross, EIS Lead
M.R.P. Regional Planning
B.S. Biology
Years of Experience: 30

David E. Schultz, Copyeditor
B.A. Liberal Arts
Years of Experience: 34

John Schroeder, Graphic Designer
B.A. Graphic Design
B.S. Civil Engineering
Years of Experience: 12

CHAPTER 7

List of Reviewers

The individual below reviewed the Tiered Final Environmental Impact Statement in November 2009.

U. S. Coast Guard

Cristal Fosbrook, Project Manager, NEPA and Environmental Planning
B.S. Geological Engineering

CHAPTER 8

References

Abt Associates. 2008. “Economic and Benefits Analysis of the Final Vessel General Permit (VGP)” December, 18.

American Iron and Steel Institute. 2001. “Annual Statistical Report, 2000.” Washington, D.C.

Benson, A.J., and D. Raikow. 2007. *Dreissena polymorpha*. USGS Nonindigenous Aquatic Species Database.

Berkman, P.A., D.W. Garton, M.A. Haltuch, G.W. Kennedy, and L.R. Febo. 2000. “Habitat Shift in Invading Species: Zebra and Quagga Mussel Population Characteristics on Shallow Soft Substrate.” *Biological Invasions*. Vol. 2. pp. 1–6.

Boatnerd.com. 2007. Great Lakes and Seaway Shipping Website. http://www.boatnerd.com. Accessed April 27, 2007.

Bunnell, David/U.S. Geological Survey. 2007. Personal communication. October 17.

CEQ (Council on Environmental Quality). 1997. “Considering Cumulative Effects under the National Environmental Policy Act.” http://www.nepa.gov/nepa/ccenepa/ccenepa.htm.

Dermott, R., and M. Munawar. 1993. “Invasion of Lake Erie Offshore Sediments by Dreissena, and its Ecological Implications.” *Canadian Journal of Fisheries and Aquatic Sciences*. Vol. 50. pp. 2298–2304.

Dun and Bradstreet. 2009. Dun and Bradstreet Business Information Reports.

Environment Canada. 2007. Bird species within the Great Lakes drainage basin. http://wildspace.ec.gc.ca/. Accessed June 16, 2007.

EPA (U.S. Environmental Protection Agency). 2001. “Great Lakes Ecosystem Report 2000.” Great Lakes National Program Office. Chicago, Ill.

EPA (U.S. Environmental Protection Agency). 2007. “Great Lakes Monitoring.” http://www.epa.gov/glnpo/monitor.html. Accessed June 1, 2007.

EPA (U.S. Environmental Protection Agency). 2008. “National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) for Discharges Incidental to the Normal Operation of Vessels: Fact Sheet.” December, 18.

GLIN (Great Lakes Information Network). 2007a. http://www.great-lakes.net/envt/flora-fauna/wildlife/bird.html#gen. Accessed December 31, 2007.

GLIN (Great Lakes Information Network). 2007b. http://www.great-lakes.net. Accessed October 19, 2007.

Grigorovich, I. A., et al. 2003. “Lake Superior: An Invasion Cold Spot?” *Hydrobiologia*. Vol. 499. pp. 191–210.

Hunter, R.D., and J.F. Bailey. 1992. "*Dreissena polymorpha* (Zebra Mussels): Colonization of Soft Substrata and Some Effects on Unionid Bivalves." *Nautilus*. Vol. 106. pp. 60–67.

International Association for Great Lakes Research. 2002. "Research and Management Priorities for Aquatic Invasive Species in the Great Lakes." http://www.iaglr.org/scipolicy/ais/index.php. Accessed November 10, 2007.

Karatayev, A.Y., L.E. Burlakova, and D.K. Padilla. 1998. "Physical Factors That Limit the Distribution and Abundance of *Dreissena polymorpha* (Pall.)." *Journal of Shellfish Research*. Vol. 17. pp. 1219–1235.

Kemp, A.L.W., and N.S. Harper. 1976. "Sedimentation Rates and a Sediment Budget for Lake Ontario." *Journal of Great Lakes Research*. Vol. 2, No. 2. pp. 324–340.

Kirkbride, Gregory/U.S. Coast Guard. 2007. Personal communication. April 26.

LCA (Lake Carriers' Association). 2007. "DCR Control Measure LCA Work Group Response." Final Product 10-30-07.

LCA (Lake Carriers' Association). 2009. Table of cargo handled by ports. Available at http://www.lcaships.com/. Accessed October 24, 2009.

LeLievre, Roger. 2006. *Know Your Ships 2006*; Marine Publishing Company. Ann Arbor, Mich.

MARAD (U.S. Maritime Administration). 2005. "Industry Survey Series, Great Lakes Operators, 2005." Office of Data and Economic Analysis.

Martin Associates. 2001. "Maritime and Mining Jobs: Economic Impact Study of the Great Lakes St. Lawrence Seaway System." Lancaster, Pa. August.

MDEQ. (2012). *State of the Great Lakes 2012.* Retrieved February 2013, from Michigan.gov - Official Website for the State of Michigan.

Mellina, E., and J.B. Rasmussen. 1994. "Patterns in the Distribution and Abundance of Zebra Mussel (*Dreissena polymorpha*) in Rivers and Lakes in Relation to Substrate and Other Physicochemical Factors." *Canadian Journal of Fisheries and Aquatic Sciences*. Vol. 51. pp. 1024–1036.

Michigan.gov. (2013). *Changes in Lake Huron's Ecosytem and Foodweb cause Chinook salmon collapse Summer 2010.* Retrieved February 2013, from Michigan.gov - Official Website for the State of Michigan: http://www.michigan.gov/documents/LakeHuronNewEcosystem-foodweb_122463_7.pdf

Michigan DEQ (Department of Environmental Quality). 2009. Shorelines of the Great Lakes. Available at http://www.michigan.gov/deq/0,1607,7-135-3313_3677-15959--,00.html. Accessed Nov. 4, 2009.

Mills, E.L., R.M. Dermott, E.F. Roseman, and D. Dustin. 1993. "Colonization, ecology, and population structure of the 'quagga' mussel (Bivalvia: Dreissenidae) in the lower Great Lakes." *Canadian Journal of Fisheries and Aquatic Sciences*. Vol. 50. pp. 2305–2314.

Nalepa, T.F., B.A. Manny, et al. 1991. "Long-Term Decline in Freshwater Mussels (Bivalvia: Unionidae) of the Western Basin of Lake Erie." *Journal of Great Lakes Research*. Vol. 17, no. 2. pp. 214–219.

Nekvasil, G. 2009/Lake Carriers Association. Personal communication Re: bulk carrier industry employment. September 23, 2009.

Palmer, R.S. 1962. *Handbook of North American Birds*. Vol. 1. *Loons Through Flamingos*. Yale University Press. New Haven, Conn.

Patterson, M. W. R., et al. 2002. "The Distribution and Abundance of *Dreissena* Species (Dreissenidae) in Lake Erie, 2002." *Journal of Great Lakes Research.* Vol. 31. pp. 223–237.

Reid, D.F., and G.A. Meadows. 1999. "Proceedings of the Workshop: The Environmental Implications of Cargo Sweepings in the Great Lakes. National Oceanic and Atmospheric Administration (NOAA)." *Technical Memorandum ERL GLERL-114*. NOAA Great Lakes Environmental Research Laboratory. Ann Arbor, Mich. 66 pp.

Snyder, F. L., M. B. Hilgendorf, and D. W. Garton. 1997. "Zebra Mussels in North America: The Invasion and Its Implications!" Ohio Sea Grant College Program, Ohio State University. Columbus.

SOLEC (State of the Lakes Ecosystem Conference). 2005. "State of the Great Lakes 2005 Indicator Sheets." http://www.epa.gov/glnpo/solec/indicator_sheets/superior.pdf. Accessed October 19, 2007.

Strum, Marie/USACE Great Lakes and Ohio River Division. 2009. Personal conversation with Mary Jo Kealy/CH2M HILL. September 29.

Transport Canada et al. 2007. "Great Lakes St. Lawrence Seaway Study Final Report." November 26, 2007. Accessed on September 30, 2009, from http://www.glsls-study.com/English%20Site/home.html.

TVA (Tennessee Valley Authority). 2005. "Transportation Rate Analysis: Great Lakes & St. Lawrence Seaway."

U.S. Coast Guard. 1997. "1997 Enforcement Policy for Cargo Residues on the Great Lakes." Ninth District. Cleveland, Ohio.

U.S. Coast Guard. 2002. "A Study of Dry Cargo Residue Discharges in the Great Lakes." Prepared for the U.S. Coast Guard, Office of Operating and Environmental Standards (G-MSO), Environmental Standards Division (G-MSO-4). Washington, D.C.

U.S. Coast Guard. 2006. "Study of Incidental Dry Cargo Residue Discharges in the Great Lakes." Prepared for the U.S. Coast Guard, Office of Standards Evaluation and Development. Washington, D.C.

U.S. Coast Guard. 2008. "Final Environmental Impact Statement: U.S. Coast Guard Rulemaking for Dry Cargo Residue Discharges in the Great Lakes. DOT Document USCG-2004-19621." http://edocket.access.gpo.gov/2008/pdf/E8-22670.pdf.

USACE (U.S. Army Corps of Engineers). 2009. “Great Lakes Navigation System: Economic Strength to the Nation.” January. http://www.lre.usace.army.mil/ETSPubs/HFS/Great%20Lakes%20Navigation-Economic%20Strength%20to%20the%20Nation.pdf.

USFWS (U.S. Fish and Wildlife Service). 2008. Species lists and information. http://www.fws.gov/midwest/endangered/. Accessed August 13, 2008.